Wastewater Master Plan

Summary

BRYAN Texas

BLACK & VEATCH
Corporation

2002

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THE CITY OF BRYAN TEXAS

Wastewater Master Plan

Summary

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Executive Summary

Executive Summary

Background

A Comprehensive study of The City of Bryan's sanitary sewer system was conducted in 1992/1993 - *Final Report for Comprehensive Inflow/Infiltration Study (March 1994)*. The City of Bryan continues to experience performance problems with the existing wastewater collection system – primarily during rainfall events. Due to these concerns and the Council's desire for growth, the City set out to develop a Wastewater Master Plan.

Goals of Master Plan

The goals of the Master Plan set by the City are as follows:

- Identify future system needs,
- Provide a flexible roadmap for developing and updating the 5 year City Improvement Plan (CIP) to meet system needs and allow The City of Bryan to stay ahead of development,
- Identify user friendly tools for modeling that can be used on an ongoing basis, and
- Contain easy to use data and graphics that properly conveys recommendations.

Regulations

Since 1972, the Clean Water Act has prohibited discharges of sanitary sewer overflows (SSOs) into the surface waters of the United States. SSOs are releases of raw sewage that pose health risks associated with exposure to pathogens. Violators are subject to civil and criminal penalties established by Federal law. Additional regulations are proposed to reduce health/environmental risks associated with SSOs.

System Review

Flow and rainfall data contained in the *Comprehensive Inflow/Infiltration Study*, service area and land use data contained in the *2000-2020 Bryan Comprehensive Plan* and population and employment projections from The City of Bryan and the Metropolitan Planning Organization were reviewed. Wastewater flows were projected for years 2005, 2010 and 2020. A computer hydraulic model was developed and calibrated. The system was evaluated for dry weather and wet weather (peak flow) conditions. Burton Creek, Still Creek and Turkey Creek wastewater treatment plants were reviewed.

Conclusions – Wastewater Collection System

Conclusions for the collection system are as follows:

- Wastewater collection system experiences system wide capacity concerns. I/I is prevalent throughout the entire existing system.
- It is not cost-effective to construct a wastewater conveyance system and treatment facilities that handle the magnitude of I/I that is available to enter the existing system.
- For purposes of this evaluation, a goal of 40 percent I/I reduction was used for evaluation of improvements.
- Growth is projected both within and outside the existing service areas. Growth in areas not currently served by the existing system will require a coordinated approach to the extension of existing system and improvements to the existing system to accommodate the increased flows.

Conclusions - Burton Creek Wastewater Treatment Plant

Conclusions for Burton Creek Wastewater Treatment Plant are as follows:

- The capacity analysis of the Burton Creek Wastewater Treatment Plant indicated the plant can treat 5.4 mgd during maximum month mass loading conditions.

- Average Daily Flow (ADF) exceeded 90 % of the evaluated capacity for at least three consecutive months.
- Based on staff input, the peak flows through the plant can exceed plant hydraulic capacity and result in solids washout.

Conclusion – Still Creek Wastewater Treatment Plant

Conclusions for Still Creek Wastewater Treatment Plant are as follows:

- The capacity analysis of the Still Creek Wastewater Treatment Plant indicated the plant can treat 2.5 mgd during maximum month mass loading conditions.
- ADF exceeded 75 % of the evaluated capacity for at least three consecutive months.
- Based on staff input, the peak flows through the plant can exceed plant hydraulic capacity and result in solids washout.

Conclusion - Turkey Creek Wastewater Treatment Plant

Conclusions for Turkey Creek Wastewater Treatment Plant are as follows:

- The capacity analysis of the Turkey Creek Wastewater Treatment Plant indicated the plant can treat 0.65 mgd during maximum month mass loading conditions.
- ADF exceeded 75 % of the evaluated capacity for at least three consecutive months.

Recommendations

Recommended actions are as follows:

- Implement and continuously maintain an Inflow and Infiltration Reduction. Program to achieve 40 percent reduction in inflow and infiltration. As a minimum activities should include:
  - Conduct flow and rainfall monitoring and analyze collected data.
  - Conduct manhole inspections and line lamping.
  - Conduct smoke testing/dyed water testing.

  - Conduct television inspections of lines.
  - Remove sources of inflow and infiltration.
  - Conduct post-rehabilitation evaluation.
- Priority Conveyance System Projects
  - Implement a phased approach for improvements to existing system to address current performance concerns and increase capacity for future flows.
  - Provide extension of existing system for future growth as necessary.
- Utilize computer hydraulic model to manage the existing system and properly plan for future development.
- Burton Creek Wastewater Treatment Plant
  - Improve capacity.
  - Conduct detailed hydraulic evaluation.
  - Coordinate modifications to plant with improvements to collection system.
- Still Creek Wastewater Treatment Plant
  - Consider ultimate diversion of flows to Westside Wastewater Treatment Plant.
- Turkey Creek Wastewater Treatment Plant
  - Consider ultimate diversion of flows to Westside Wastewater Treatment Plant.
- Westside Wastewater Treatment Plant
  - Consider new facility to serve west side of city.

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Section Six

Wastewater Collection System Evaluation

6.0 Wastewater Collection System Evaluation

6.1 Introduction

This chapter describes results of the evaluation of the existing collection system and its overloaded condition in meeting future needs. Preliminary recommendations for correcting deficiencies are described in the following chapter. All analyses were performed using 5-year frequency design storm events.

6.2 Methodology

For planning purposes, The City of Bryan requested that recommendations for capacity increases be based on replacement of pipe rather than constructing parallel lines that would increase length of sewer to be maintained. The model runs were performed on that basis with same general concept for replacing pump stations and force mains. This concept usually produces highest cost alternative that can be refined later as more detailed engineering design is performed. Pump capacities were adjusted to allow free flow conditions for upstream collection system to the lift station.

As discussed in Section 4.5 this analysis was performed assuming The City of Bryan would initiate a 40 percent I/I reduction plan.

Flow projections discussed in Chapter 3 were used as the basis for future model scenarios and were determined using a variety of inflow components based upon a 5-year design curve. Inflow components utilized included the following:

- density – 4 capita per acre used for all future growth areas,
- infiltration – 50 gallons per acre per day used for all future growth areas,
- Kp, inflow coefficient – 0.004 used for all future growth areas,
- shape factor – determined using regression analysis, and
- Tc, time of concentration – determined as a function of area.

These components were combined with population projections to predict future infiltration, ADDF, and developed acreage. See Tables 3-16 and 3-17 for inflow components summarized by subbasin. See Figure 3-2 for schematic of future system as modeled.

6.3 Conditions of Existing System

Findings of this study support the *Comprehensive I/I Study (March 1994)* regarding excessive inflow/infiltration throughout major portions of the system.

Model runs of post-improvement modeling since 1993 would hopefully report better protection levels throughout the system. The City of Bryan has completed rehabilitation work that should reduce 50 percent of overloaded lines in 1993 toward the 25.1 percent desirable by 2005. For this report two criterion were developed to represent an overloaded pipe. One, depth criterion means that the upstream manhole of the pipe is surcharged, and the other is flow criterion which suggests that the maximum flow in the pipe exceeded the capacity of pipe.

Table 6-1 lists number, length, and percent of modeled lines overloaded by service area. In 1993 the Burton Creek Service Area had 522 overloaded pipes representing 50 percent of the collection system modeled. A full 68 percent of the modeled overloaded pipes are in this service area. Of the modeled network, the Burton Creek Service Area represents only 57.7 percent.

Table 6-1
1993 Modeled Pipe Surcharge and Overloading Summary

Service Area	Pipes Overloaded	Overloaded Pipe Length (ft)	Percent Overloaded (%)	Percent of Modeled Network (%)
Burton Creek	364	137,099	34.2	57.7
Still Creek	132	56,027	14.0	33.2
Turkey Creek	26	7,596	1.9	9.1
Total	**522**	**200,722**	**50.1**	**100.0**

A detailed listing of overloaded pipe modeled as per 1993 conditions is provided in Appendix A. This includes pipe capacity and 5-year flow and utilization pipe. Pipe at full utilization is expressed as the whole number 1. Half pipe utilization would be expressed 0.50 and 50 percent overloaded would be expressed 1.50.

Exhibit 6-1 presents existing and future capacity deficiencies, based on 1993 data without benefit of post-improvement flow data. Information provided is based on a 5 year storm event with 40 percent of I/I removed by year 2005 and assumes future growth projections for the planning years.

6.4 System Evaluation for Future Scenarios

Three model runs were performed to identify pipes, pump stations and force mains deficient in conveying future peak flows through The City of Bryan's collection system under 5-year design flow conditions. These included scenarios representing the future condition for years 2005, 2010, and 2020. Condition results for year 2020 were used to define the CIP. Conditions for planning years 2005 and 2010 provide a guide for implementation scheduling.

The following Appendices provide details including capacity, 5-year flow, and utilization of pipe in a 5-year storm event for the planning years:

- Appendix B: Projected Wastewater System Summary for Year 2005 with 40 percent I/I Removed – All Modeled Pipes
- Appendix C: Projected Wastewater System Summary for Year 2010 with 40 percent I/I Removed – All Modeled Pipes
- Appendix D: Projected Wastewater System Summary for Year 2020 with 40 percent I/I Removed – All Modeled Pipes

Much of The City of Bryan's Wastewater Master Plan depends on the issue of I/I removal. Table 6-2 provides a summary of surcharged and overloaded pipe and the impact of I/I removal. The model identifies 554 lines totaling 206,544 feet, or 39 miles, that will be overloaded by year 2020, if no I/I removal has been accomplished. If 40 percent of the projected I/I by year 2020 is removed, only 27 miles of the modeled system will be overloaded. This would reduce the overloaded percent of the modeled system by 14.1 percent below that of the 1993 conditions.

Table 6-2
Pipe Surcharge and Overloading Summary

Scenario Year	Pipes Overloaded	Overloaded Pipe Length (ft)	Percent Overloaded (%)
1993	522	200,722	50.0
2020 (no I/I removal)	554	206,544	51.5
2020 (40% I/I removal)	363	144,015	35.9

Specific problems revealed from the model and shown on Exhibit 6-1 are as follows by service area.

6.4.1 Burton Creek Service Area

The Burton Creek Service Area has the highest concentration of sewers with capacity problems, including all of the main collectors to the treatment plant. Even with 40 percent I/I removal, sewer capacities will require increases to accommodate planned growth, particularly north and east of Earl Rudder Freeway.

The main collectors extending through the area near the intersection of Texas Avenue and Villa Maria Road also have sewer capacity deficiencies. Some of the older parallel sewers in this area should be replaced with bigger pipes consolidating flows and reducing length of sewer to be maintained.

Parallel sewer lines are common place throughout the three service areas. Consolidation of flows should be considered where construction will be required to establish required capacities. However, saving the newest or largest existing pipe is often found to be more economical. Further detailed analysis conducted during final design of each line will be required for those determinations.

6.4.2 Still Creek Service Area

Parallel sewers in Still Creek Service Area will need the same determination near the creek along the western edge of the service area. Collector sewer extending east, crossing San Jacinto Avenue, and easterly two blocks north of William J. Bryan requires upsizing.

Lines upstream from Flygt #1 Lift Station and Cottonwood Lift Station are currently undersized and will have further overloading as planned growth occurs through the study planning period. Detailed studies should be performed regarding those lift stations and the impact of upsizing pipes to serve growth needs.

6.4.3 Turkey Creek Service Area

The Turkey Creek Service Area has two collectors that will also be overloaded as growth requirements develop.

6.4.4 Strategic Planning

Strategic planning should be performed before remedial actions are taken. Review of tables provided in the Appendices clearly denote capacity problems throughout the system. Overflows will need to cease to satisfy increasingly demanding federal and state requirements.

It is important to note the impact of upsizing collector systems before downstream pipe facilities are upgraded. Chapter 5 describes capacity problems at the treatment plants. Like the treatment plants, lift stations would have serious overload problems if their contributing collections systems were upsized. Forcing overflows to new locations or increasing flooding volumes or occurrences would likely place The City of Bryan at legal risk.

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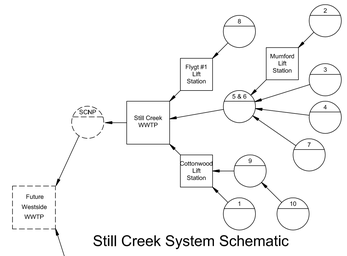
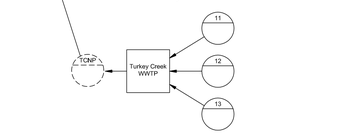


Still Creek System Schematic



Turkey Creek System Schematic

Burton Creek System Schematic

Legend

B18	Subsystem Boundaries
	Existing Service Area Boundaries
	Existing Analyzed Areas
	Existing City Limits
	2020 Service Area
	Non-Modeled Pipes
	Modeled Pipe
●	Existing Lift Station
■	Wastewater Treatment Plant
	Streams
	Ridge Lines
	Major Roads and Highways
⬟	Police Department
▲	School
◑	Fire Station

Capacity Exceeded Information

- Existing Sewer Capacity Exceeded, or will be by 2005
- Existing Sewer Capacity Exceeded by 2010
- Existing Sewer Capacity Exceeded by 2020

Note: Wastewater Collection System Capacity Problems shown are based on a 40% reduction in Inflow and Infiltration Flows

1 0 1
SCALE IN MILES

EXISTING PIPE CAPACITIES EXCEEDED

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Exhibit 6-1

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7

Section Seven

Capital Improvement Plan

7.0 Capital Improvement Plans

7.1 Introduction

A master plan is a planning level document. As such, the associated Capital Improvement Plan (CIP) is used as a planning tool to identify the general system needs projects, the timeframe associated with the execution of the projects and planning level costs associated with each project. Throughout the planning period, various technical, regulatory, financial, social and political issues will affect the scope, timing and costs associated with each project identified in the CIP. Further refinement is conducted during the preliminary and final design stages of each project.

The CIP developed during the preparation of this Master Plan is reflected in the following tables and exhibits.

- Table 7-1 reflects the identified projects that improve the existing system and prepare it for future growth based on a year 2005 cost basis.
- Table 7-2 reflects the identified projects that improve the existing system and prepare it for future growth phased throughout the planning period.
- Table 7-3 reflects the potential sewer extensions for future growth based on a year 2005 cost basis.
- Table 7-4 reflects the potential sewer extensions for future growth phased throughout the planning period.
- Table 7-5 identifies the improvements associated with each relief sewer project shown in Exhibit 7-1.
- Exhibit 7-1 reflects the overall map of improvements.
- Exhibit 7-2 reflects the improvements within the existing service area at a larger scale on four panels. Due to the scale of each panel, some ultimate sewer extensions are not shown.

City of Bryan

Wastewater Collection System Master Plan

Table 7-1 - Relief Sewer Summary (Completion by 2005)

Relief Sewer Summary Data				Opinion of Probable Capital Cost			
Project No.	Length (ft)	Diameter (in)	Design Flow (mgd)	2005 (2005 Cost Basis)	2010 (2010 Cost Basis)	2015 (2015 Cost Basis)	2020 (2020 Cost Basis)
001	5,892	66	23.7	$5,779,210	N/A	N/A	N/A
002	4,230	30	4.6	$1,490,399	N/A	N/A	N/A
003	2,687	21	1.2	$634,195	N/A	N/A	N/A
004	4,883	21-27	2.8	$1,152,499	N/A	N/A	N/A
005	3,662	12-24	1.9	$827,651	N/A	N/A	N/A
006	7,661	54-66	21.3	$6,769,327	N/A	N/A	N/A
007	5,603	27-30	5.5	$1,894,090	N/A	N/A	N/A
008	4,162	12-24	2.5	$930,395	N/A	N/A	N/A
009	4,678	54	19.5	$3,500,686	N/A	N/A	N/A
010	7,504	30	7.7	$2,653,565	N/A	N/A	N/A
011	6,657	12-27	4.0	$1,738,373	N/A	N/A	N/A
012	6,045	36-42	11.7	$2,752,069	N/A	N/A	N/A
013	3,414	27-30	8.3	$1,135,385	N/A	N/A	N/A
014	6,620	18-27	3.8	$1,674,064	N/A	N/A	N/A
015	4,872	30-54	13.7	$2,835,443	N/A	N/A	N/A
016	4,364	36-60	15.0	$3,118,822	N/A	N/A	N/A
017	5,189	12-33	4.4	$1,586,425	N/A	N/A	N/A
018	7,725	18-27	3.4	$2,137,854	N/A	N/A	N/A
019	1,342	12-24	1.2	$315,491	N/A	N/A	N/A
020	3,213	30-33	7.2	$1,143,020	N/A	N/A	N/A
021	3,835	15-21	1.2	$795,905	N/A	N/A	N/A
022	1,513	27	3.2	$484,145	N/A	N/A	N/A
023	4,519	18-30	5.0	$1,352,110	N/A	N/A	N/A
025	287	15	1.4	$57,316	N/A	N/A	N/A
026	8,009	15-24	2.3	$1,872,512	N/A	N/A	N/A
101	6,855	24-30	5.5	$2,916,367	N/A	N/A	N/A
102	5,379	15-24	3.0	$1,317,685	N/A	N/A	N/A
103	9,001	18-27	3.6	$3,569,074	N/A	N/A	N/A
104	1,757	30	5.2	$621,310	N/A	N/A	N/A
105	2,624	30	6.1	$927,897	N/A	N/A	N/A
106	3,934	24	1.0	$1,027,723	N/A	N/A	N/A
107	5,131	15-27	3.5	$1,260,597	N/A	N/A	N/A
108	914	18-24	1.0	$220,438	N/A	N/A	N/A
109	4,799	15-27	1.5	$1,190,707	N/A	N/A	N/A
110	3,019	15-18	2.7	$645,039	N/A	N/A	N/A
111	350	27	4.8	$111,997	N/A	N/A	N/A
201	4,663	15-21	2.3	$1,071,487	N/A	N/A	N/A
202	5,298	42	4.4	$2,693,758	N/A	N/A	N/A
Total	172,290			$66,205,029	N/A	N/A	N/A
Grand Total							$66,205,029

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Wastewater Collection System Master Plan

Table 7-2 - Relief Sewer Summary (Phased Completion)

Relief Sewer Summary Data				Opinion of Probable Capital Cost By Time Period			
Project No.	Length (ft)	Diameter (in)	Design Flow (mgd)	2005 (2005 Cost Basis)	2010 (2010 Cost Basis)	2015 (2015 Cost Basis)	2020 (2020 Cost Basis)
001	5,892	66	23.7	$5,779,210	$0	$0	$0
002	4,230	30	4.6	$1,490,399	$0	$0	$0
003	2,687	21	1.2	$0	$0	$852,305	$0
004	4,883	21-27	2.8	$1,152,499	$0	$0	$0
005	3,662	12-24	1.9	$0	$0	$0	$1,289,453
006	7,661	54-66	21.3	$6,769,327	$0	$0	$0
007	5,603	27-30	5.5	$0	$2,195,770	$0	$0
008	4,162	12-24	2.5	$0	$1,078,583	$0	$0
009	4,678	54	19.5	$0	$4,058,254	$0	$0
010	7,504	30	7.7	$0	$3,076,209	$0	$0
011	6,657	12-27	4.0	$0	$2,015,251	$0	$0
012	6,045	36-42	11.7	$0	$3,190,402	$0	$0
013	3,414	27-30	8.3	$0	$1,316,222	$0	$0
014	6,620	18-27	3.8	$0	$0	$0	$2,608,137
015	4,872	30-54	13.7	$2,835,443	$0	$0	$0
016	4,364	36-60	15.0	$3,118,822	$0	$0	$0
017	5,189	12-33	4.4	$1,586,425	$0	$0	$0
018	7,725	18-27	3.4	$0	$0	$2,873,097	$0
019	1,342	12-24	1.2	$0	$0	$423,993	$0
020	3,213	30-33	7.2	$1,143,020	$0	$0	$0
021	3,835	15-21	1.2	$0	$0	$1,069,629	$0
022	1,513	27	3.2	$0	$0	$650,650	$0
023	4,519	18-30	5.0	$0	$1,567,466	$0	$0
025	287	15	1.4	$0	$0	$0	$89,296
026	8,009	15-24	2.3	$0	$0	$2,516,499	$0
101	6,855	24-30	5.5	$0	$0	$0	$4,543,604
102	5,379	15-24	3.0	$0	$0	$1,770,858	$0
103	9,001	18-27	3.6	$0	$0	$0	$5,560,500
104	1,757	30	5.2	$0	$0	$0	$967,981
105	2,624	30	6.1	$927,897	$0	$0	$0
106	3,934	24	1.0	$1,027,723	$0	$0	$0
107	5,131	15-27	3.5	$1,260,597	$0	$0	$0
108	914	18-24	1.0	$0	$255,548	$0	$0
109	4,799	15-27	1.5	$1,190,707	$0	$0	$0
110	3,019	15-18	2.7	$0	$0	$866,879	$0
111	350	27	4.8	$0	$0	$0	$174,488
201	4,663	15-21	2.3	$0	$1,242,147	$0	$0
202	5,298	42	4.4	$0	$3,122,804	$0	$0
Total	172,290			$28,282,069	$23,118,657	$11,023,911	$15,233,460
Grand Total							$77,658,097

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City of Bryan
Wastewater Collection System Master Plan
Table 7-3 - Potential Sewer Extensions for Future Growth (Completion by 2005)

Summary Data								Opinion of Probable Capital Costs				Summary Data		
Project	ID	Type	Length (ft)	Diameter (in)	Pump Station Capacity (mgd)	Unit Cost	Cost Unit	2005 Capital Cost ($ - 2005 Basis)	2010 Capital Cost ($ - 2010 Basis)	2015 Capital Cost ($ - 2015 Basis)	2020 Capital Cost ($ - 2020 Basis)	Cumulative Area (acres)	Flow Rate, (cfs/acre)	Flow (mgd)
E20.1	1	Gravity	3,900	24	-	$ 6.50	$/in-dia	$ 997,223	N/A	N/A	N/A	730	0.010	4.718
E20.1	2	Gravity	12,100	36	-	$ 6.50	$/in-dia	$ 4,640,921	N/A	N/A	N/A	2100	0.008	10.858
E20.1	3	PS	na	-	15	$ 0.20	$/gal	$ 4,917,272	N/A	N/A	N/A	2830	0.008	14.632
E20.1	4	FM	16,800	30	-	$ 4.00	$/in-dia	$ 3,304,406	N/A	N/A	N/A	2830	0.008	14.632
E20.1	5	Gravity	1,600	36	-	$ 6.50	$/in-dia	$ 613,675	N/A	N/A	N/A	2830	0.008	14.632
E20.2	1	Gravity	3,200	24	-	$ 6.50	$/in-dia	$ 818,234	N/A	N/A	N/A	490	0.012	3.800
E20.2	2	PS	na	-	3.8	$ 0.35	$/gal	$ 2,179,990	N/A	N/A	N/A	490	0.012	3.800
E20.2	3	FM	3,700	16	-	$ 4.00	$/in-dia	$ 388,137	N/A	N/A	N/A	490	0.012	3.800
E20.2	4	Gravity	3,200	24	-	$ 6.50	$/in-dia	$ 818,234	N/A	N/A	N/A	490	0.012	3.800
E17.1	1	Gravity	2,500	24	-	$ 6.50	$/in-dia	$ 639,245	N/A	N/A	N/A	760	0.010	4.912
E17.1	2	PS	na	-	5	$ 0.35	$/gal	$ 2,868,408	N/A	N/A	N/A	760	0.010	4.912
E17.1	3	FM	3,000	20	-	$ 4.00	$/in-dia	$ 393,382	N/A	N/A	N/A	760	0.010	4.912
E17.1	4	Gravity	2,300	30	-	$ 6.50	$/in-dia	$ 735,132	N/A	N/A	N/A	1250	0.010	8.079
E17.2	1	Gravity	3,700	24	-	$ 6.50	$/in-dia	$ 946,083	N/A	N/A	N/A	490	0.012	3.800
E17.2	2	PS	na	-	3.8	$ 0.35	$/gal	$ 2,179,990	N/A	N/A	N/A	490	0.012	3.800
E17.2	3	FM	3,700	16	-	$ 4.00	$/in-dia	$ 388,137	N/A	N/A	N/A	490	0.012	3.800
E17.2	4	Gravity	11,000	30	-	$ 6.50	$/in-dia	$ 3,515,849	N/A	N/A	N/A	1430	0.010	9.242
E14.1	1	Gravity	3,200	24	-	$ 6.50	$/in-dia	$ 818,234	N/A	N/A	N/A	550	0.010	3.555
E14.1	2	PS	na	-	3.6	$ 0.35	$/gal	$ 2,065,254	N/A	N/A	N/A	550	0.010	3.555
E14.1	3	FM	3,700	20	-	$ 4.00	$/in-dia	$ 485,171	N/A	N/A	N/A	550	0.010	3.555
E14.1	4	Gravity	4,600	30	-	$ 6.50	$/in-dia	$ 1,470,264	N/A	N/A	N/A	1310	0.010	8.467
E14.1	5	Gravity	11,500	36	-	$ 6.50	$/in-dia	$ 4,410,793	N/A	N/A	N/A	2370	0.008	12.254
E14.1	6	PS	na	-	21.5	$ 0.15	$/gal	$ 5,286,067	N/A	N/A	N/A	4070	0.008	21.044
E14.1	7	Gravity	11,300	30	-	$ 6.50	$/in-dia	$ 3,611,736	N/A	N/A	N/A	1700	0.010	10.987
E14.1	8	FM	6,900	30	-	$ 4.00	$/in-dia	$ 1,357,167	N/A	N/A	N/A	4070	0.008	21.044
E14.1	9	Gravity	4,600	42	-	$ 6.50	$/in-dia	$ 2,058,370	N/A	N/A	N/A	4530	0.008	23.422
E8.1	1	Gravity	12,500	36	-	$ 6.50	$/in-dia	$ 4,794,340	N/A	N/A	N/A	1800	0.010	11.633
E8.1	2	Gravity	7,600	24	-	$ 6.50	$/in-dia	$ 1,943,306	N/A	N/A	N/A	800	0.010	5.170
E8.1	3	Gravity	9,900	36	-	$ 6.50	$/in-dia	$ 3,797,117	N/A	N/A	N/A	3200	0.008	16.545
E8.2	1	Gravity	18,400	30	-	$ 6.50	$/in-dia	$ 5,881,057	N/A	N/A	N/A	1800	0.010	11.633
E5.1	1	Gravity	8,500	24	-	$ 6.50	$/in-dia	$ 2,173,434	N/A	N/A	N/A	640	0.010	4.136
E5.2	1	Gravity	5,800	24	-	$ 6.50	$/in-dia	$ 1,483,049	N/A	N/A	N/A	490	0.012	3.800
E8.3	1	Gravity	6,200	24	-	$ 6.50	$/in-dia	$ 1,585,328	N/A	N/A	N/A	730	0.010	4.718
E8.3	2	Gravity	3,900	18	-	$ 6.50	$/in-dia	$ 747,917	N/A	N/A	N/A	430	0.012	3.335
E8.3	3	Gravity	8,000	30	-	$ 6.50	$/in-dia	$ 2,556,981	N/A	N/A	N/A	1430	0.010	9.242
E8.3	4	Gravity	13,300	24	-	$ 6.50	$/in-dia	$ 3,400,785	N/A	N/A	N/A	1100	0.010	7.109
E8.3	5	Gravity	3,100	30	-	$ 6.50	$/in-dia	$ 990,830	N/A	N/A	N/A	(1) N/A	N/A	9.565
E8.3	6	Gravity	6,900	36	-	$ 6.50	$/in-dia	$ 2,646,476	N/A	N/A	N/A	(1) N/A	N/A	13.120
E8.3	7	Gravity	2,500	42	-	$ 6.50	$/in-dia	$ 1,118,679	N/A	N/A	N/A	(1) N/A	N/A	21.199
E8.3	8	Gravity	12,700	42	-	$ 6.50	$/in-dia	$ 5,682,891	N/A	N/A	N/A	(1) N/A	N/A	14.219
E8.3	9	Gravity	16,700	54	-	$ 6.50	$/in-dia	$ 9,607,857	N/A	N/A	N/A	(1) N/A	N/A	38.519
E8.3	10	Gravity	18,700	60	-	$ 6.50	$/in-dia	$ 11,953,887	N/A	N/A	N/A	(1) N/A	N/A	47.762
E13.2	1	Gravity	6,000	18	-	$ 6.50	$/in-dia	$ 1,150,642	N/A	N/A	N/A	520	0.010	3.361
E13.1	1	Gravity	6,600	42	-	$ 6.50	$/in-dia	$ 2,953,313	N/A	N/A	N/A	(1) N/A	N/A	11.375
Total			283,800		53			$ 116,375,262	N/A	N/A	N/A			
Grand Total											$ 116,375,262			

(1) Flows are estimated from model output and new area flow calculations resulting in ultimate buildout.

(2) 2005 Costs for Projects E8.3 and E13.1 are Easement Acquisition Costs Only

BLACK & VEATCH Corporation

City of Bryan
Wastewater Collection System Master Plan
Table 7-4 - Potential Sewer Extensions for Future Growth (Phased Completion)

Summary Data								Opinion of Probable Capital Costs				Summary Data		
Project	ID	Type	Length (ft)	Diameter (in)	Pump Station Capacity (mgd)	Unit Cost	Cost Unit	2005 Capital Cost ($ - 2005 Basis)	2010 Capital Cost ($ - 2010 Basis)	2015 Capital Cost ($ - 2015 Basis)	2020 Capital Cost ($ - 2020 Basis)	Cumulative Area (acres)	Flow Rate, (cfs/acre)	Flow (mgd)
E20.1	1	Gravity	3,900	24	-	$ 6.50	$/in-dia			$ 1,340,184		730	0.010	4.718
E20.1	2	Gravity	12,100	36	-	$ 6.50	$/in-dia			$ 6,237,010		2100	0.008	10.858
E20.1	3	PS	na	-	15	$ 0.20	$/gal			$ 6,608,402		2830	0.008	14.632
E20.1	4	FM	16,800	30	-	$ 4.00	$/in-dia			$ 4,440,846		2830	0.008	14.632
E20.1	5	Gravity	1,600	36	-	$ 6.50	$/in-dia			$ 824,729		2830	0.008	14.632
E20.2	1	Gravity	3,200	24	-	$ 6.50	$/in-dia	$ 818,234				490	0.012	3.800
E20.2	2	PS	na	-	3.8	$ 0.35	$/gal	$ 2,179,990				490	0.012	3.800
E20.2	3	FM	3,700	16	-	$ 4.00	$/in-dia	$ 388,137				490	0.012	3.800
E20.2	4	Gravity	3,200	24	-	$ 6.50	$/in-dia	$ 818,234				490	0.012	3.800
E17.1	1	Gravity	2,500	24	-	$ 6.50	$/in-dia			$ 859,092		760	0.010	4.912
E17.1	2	PS	na	-	5	$ 0.35	$/gal			$ 3,854,901		760	0.010	4.912
E17.1	3	FM	3,000	20	-	$ 4.00	$/in-dia			$ 528,672		760	0.010	4.912
E17.1	4	Gravity	2,300	30	-	$ 6.50	$/in-dia			$ 987,956		1250	0.010	8.079
E17.2	1	Gravity	3,700	24	-	$ 6.50	$/in-dia			$ 1,271,456		490	0.012	3.800
E17.2	2	PS	na	-	3.8	$ 0.35	$/gal			$ 2,929,725		490	0.012	3.800
E17.2	3	FM	3,700	16	-	$ 4.00	$/in-dia			$ 521,623		490	0.012	3.800
E17.2	4	Gravity	11,000	30	-	$ 6.50	$/in-dia			$ 4,725,007		1430	0.010	9.242
E14.1	1	Gravity	3,200	24	-	$ 6.50	$/in-dia				$ 1,274,782	550	0.010	3.555
E14.1	2	PS	na	-	3.6	$ 0.35	$/gal				$ 3,217,598	550	0.010	3.555
E14.1	3	FM	3,700	20	-	$ 4.00	$/in-dia				$ 755,880	550	0.010	3.555
E14.1	4	Gravity	4,600	30	-	$ 6.50	$/in-dia				$ 2,290,624	1310	0.010	8.467
E14.1	5	Gravity	11,500	36	-	$ 6.50	$/in-dia				$ 6,871,871	2370	0.008	12.254
E14.1	6	PS	na	-	21.5	$ 0.15	$/gal				$ 8,235,520	4070	0.008	21.044
E14.1	7	Gravity	11,300	30	-	$ 6.50	$/in-dia				$ 5,626,967	1700	0.010	10.987
E14.1	8	FM	6,900	30	-	$ 4.00	$/in-dia				$ 2,114,422	4070	0.008	21.044
E14.1	9	Gravity	4,600	42	-	$ 6.50	$/in-dia				$ 3,206,873	4530	0.008	23.422
E8.1	1	Gravity	12,500	36	-	$ 6.50	$/in-dia				$ 7,469,425	1800	0.010	11.633
E8.1	2	Gravity	7,600	24	-	$ 6.50	$/in-dia				$ 3,027,607	800	0.010	5.170
E8.1	3	Gravity	9,900	36	-	$ 6.50	$/in-dia			$ 5,103,008		3200	0.008	16.545
E8.2	1	Gravity	18,400	30	-	$ 6.50	$/in-dia				$ 9,162,495	1800	0.010	11.633
E5.1	1	Gravity	8,500	24	-	$ 6.50	$/in-dia			$ 2,920,914		640	0.010	4.136
E5.2	1	Gravity	5,800	24	-	$ 6.50	$/in-dia			$ 1,993,094		490	0.012	3.800
E8.3	1	Gravity	6,200	24	-	$ 6.50	$/in-dia	$ 158,533	$ 1,654,047			730	0.010	4.718
E8.3	2	Gravity	3,900	18	-	$ 6.50	$/in-dia	$ 74,792	$ 780,337			430	0.012	3.335
E8.3	3	Gravity	8,000	30	-	$ 6.50	$/in-dia	$ 255,698	$ 2,667,818			1430	0.010	9.242
E8.3	4	Gravity	13,300	24	-	$ 6.50	$/in-dia	$ 340,078	$ 3,548,198			1100	0.010	7.109
E8.3	5	Gravity	3,100	30	-	$ 6.50	$/in-dia	$ 99,083	$ 1,033,779			(1) N/A	N/A	9.565
E8.3	6	Gravity	6,900	36	-	$ 6.50	$/in-dia	$ 264,648	$ 2,761,191			(1) N/A	N/A	13.120
E8.3	7	Gravity	2,500	42	-	$ 6.50	$/in-dia	$ 111,868	$ 1,167,170			(1) N/A	N/A	21.199
E8.3	8	Gravity	12,700	42	-	$ 6.50	$/in-dia	$ 568,289	$ 5,929,225			(1) N/A	N/A	14.219
E8.3	9	Gravity	16,700	54	-	$ 6.50	$/in-dia	$ 960,786	$ 10,024,325			(1) N/A	N/A	38.519
E8.3	10	Gravity	18,700	60	-	$ 6.50	$/in-dia	$ 1,195,389	$ 12,472,048			(1) N/A	N/A	47.762
E13.2	1	Gravity	6,000	18	-	$ 6.50	$/in-dia	$ 1,150,642				520	0.010	3.361
E13.1	1	Gravity	6,600	42	-	$ 6.50	$/in-dia	$ 295,331	$ 3,081,330			(1) N/A	N/A	11.375
Total			283,800		53			$ 9,679,731	$ 45,119,468	$ 45,146,618	$ 53,254,064			
Grand Total											$ 153,199,881			

(1) Flows are estimated from model output and new area flow calculations resulting in ultimate buildout.

(2) 2005 Costs for Projects E8.3 and E13.1 are Easement Acquisition Costs Only

BLACK & VEATCH Corporation

City of Bryan
Wastewater Collection System Master Plan
Table 7 - 5 Relief Sewers CIP Projects For Year 2020 With 40% I/I Removed

U/S Node	D/S Node	Pipe Length (ft)	Design (5yr) Flow (cfs)	Proposed Diameter (in)	Proposed CIP Construction Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2005 Costs Basis)	Project Number	Subsystem No.
Project 001									
BC0282	BC0345	263	36.75	66	$157,383	$236,075	$257,965	001	B19
BC0283	BC0282	123	36.72	66	$73,605	$110,408	$120,645	001	B19
BC0284	BC0283	70	36.69	66	$41,889	$62,834	$68,660	001	B19
BC0285	BC0284	71	36.66	66	$42,488	$63,732	$69,642	001	B19
BC0286	BC0285	1,731	36.67	66	$1,035,857	$1,553,786	$1,697,863	001	B19
BC0287	BC0286	411	36.67	66	$245,948	$368,922	$403,131	001	B19
BC0292	BC0287	622	36.70	66	$372,214	$558,321	$610,092	001	B19
BC0293	BC0292	427	36.71	66	$255,524	$383,286	$418,827	001	B19
BC0294	BC0293	474	36.73	66	$283,649	$425,474	$464,926	001	B19
BC0295	BC0294	750	36.77	66	$448,812	$673,218	$735,643	001	B19
BC0296	BC0295	950	36.86	66	$568,495	$852,743	$931,815	001	B19
Project 001 Total		5,892			$3,525,864	$5,288,796	$5,779,210		
Project 002									
BC0009	BC0008	654	7.16	30	$141,095	$211,643	$231,267	002	
BC0010	BC0009	451	7.19	30	$97,300	$145,950	$159,484	002	B20
BC0011	BC0010	330	7.16	30	$71,194	$106,791	$116,693	002	B20
BC0012	BC0011	361	7.12	30	$77,882	$116,823	$127,656	002	B20
BC0013	BC0012	465	7.07	30	$100,320	$150,480	$164,434	002	B20
BC0014	BC0013	604	7.03	30	$130,308	$195,462	$213,587	002	B20
BC0015	BC0014	451	6.99	30	$97,300	$145,950	$159,484	002	B20
BC0016	BC0015	455	6.95	30	$98,163	$147,245	$160,898	002	B20
BC0017	BC0016	298	6.90	30	$64,291	$96,437	$105,379	002	B20
BC0018	BC0017	161	5.62	27	$31,431	$47,147	$51,518	002	B20
Project 002 Total		4,230			$909,284	$1,363,926	$1,490,399		

City of Bryan
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Table 7 - 5 Relief Sewers CIP Projects For Year 2020 With 40% I/I Removed

U/S Node	D/S Node	Pipe Length (ft)	Design (5yr) Flow (cfs)	Proposed Diameter (in)	Proposed CIP Construction Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2005 Costs Basis)	Project Number	Subsystem No.
Project 003									
BC0160	BC0017	348	2.18	21	$50,111	$75,167	$82,136	003	B20
BC0161	BC0160	347	2.03	21	$49,967	$74,951	$81,900	003	B20
BC0162	BC0161	342	1.87	21	$49,247	$73,871	$80,720	003	B20
BC0163A	BC0162	314	1.71	21	$45,214	$67,821	$74,110	003	B20
BC0164	BC0163A	388	1.56	21	$55,870	$83,805	$91,576	003	B20
BC0165	BC0164	297	1.38	21	$42,768	$64,152	$70,101	003	B20
BC0166	BC0165	310	1.20	21	$44,639	$66,959	$73,167	003	B20
BC0167	BC0166	185	1.00	21	$26,640	$39,960	$43,665	003	B20
BC0171	BC0167	156	0.81	21	$22,463	$33,695	$36,819	003	B20
Project 003 Total		2,687			$386,919	$580,379	$634,195		
Project 004									
BC0033	BC0032	319	4.42	21	$45,935	$68,903	$75,292	004	B20
BC0034	BC0033	328	4.30	21	$47,230	$70,845	$77,414	004	B20
BC0035	BC0034	417	4.19	21	$60,047	$90,071	$98,422	004	B20
BC0036	BC0035	53	4.06	21	$7,631	$11,447	$12,508	004	B20
BC0051	BC0036	405	2.85	21	$58,319	$87,479	$95,590	004	B20
BC0052	BC0051	427	2.70	21	$61,486	$92,229	$100,781	004	B20
BC0053	BC0052	424	2.55	21	$61,055	$91,583	$100,075	004	B20
BC0054	BC0053	397	2.40	21	$57,167	$85,751	$93,702	004	B20
BC0055	BC0054	297	2.23	21	$42,768	$64,152	$70,101	004	B20
BC0056	BC0055	370	2.06	21	$53,278	$79,917	$87,327	004	B20
BC0057	BC0056	590	1.74	21	$84,957	$127,436	$139,252	004	B20
BC0058	BC0057	345	1.55	21	$49,678	$74,517	$81,427	004	B20
BC0060	BC0058	101	1.36	21	$14,543	$21,815	$23,837	004	B20
BC0068	BC0060	79	1.17	21	$11,376	$17,064	$18,646	004	B20

City of Bryan
Wastewater Collection System Master Plan
Table 7 - 5 Relief Sewers CIP Projects For Year 2020 With 40% I/I Removed

U/S Node	D/S Node	Pipe Length (ft)	Design (5yr) Flow (cfs)	Proposed Diameter (in)	Proposed CIP Construction Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2005 Costs Basis)	Project Number	Subsystem No.
BC0069	BC0068	331	0.98	21	$47,663	$71,495	$78,124	004	B20
Project 004 Total		4,883			$703,133	$1,054,700	$1,152,499		
Project 005									
BC0224A	BC0298	449	4.30	24	$71,562	$107,343	$117,297	005	B19
BC0225	BC0224A	516	1.93	15	$62,867	$94,301	$103,045	005	B19
BC0261	BC0224A	510	2.33	15	$62,135	$93,203	$101,845	005	B19
BC0265	BC0261	215	2.15	15	$26,195	$39,293	$42,936	005	B19
BC0266	BC0265	136	1.95	15	$16,570	$24,855	$27,160	005	B19
BC0267	BC0266	323	1.75	15	$39,353	$59,030	$64,503	005	B19
BC0268	BC0267	67	1.54	12	$7,092	$10,638	$11,624	005	B19
BC0269	BC0268	211	1.33	12	$22,334	$33,501	$36,607	005	B19
BC0297	BC0296	762	4.51	24	$121,449	$182,174	$199,066	005	B19
BC0298	BC0297	473	4.44	24	$75,388	$113,082	$123,568	005	B19
Project 005 Total		3,662			$504,945	$757,418	$827,651		
Project 006									
BC1205	BC0296	1,500	36.18	66	$897,623	$1,346,435	$1,471,285	006	B19
BC1206	BC1205	600	36.19	66	$359,049	$538,574	$588,514	006	B19
BC1208	BC2464	29	33.64	66	$17,353	$26,030	$28,443	006	B19
BC1209	BC1208	350	31.18	66	$209,445	$314,168	$343,299	006	B19
BC1210	BC1209	50	31.15	66	$29,921	$44,882	$49,043	006	B19
BC1214	BC1210	700	31.15	66	$418,891	$628,337	$686,600	006	B19
BC1215	BC1214	270	31.15	54	$123,269	$184,904	$202,049	006	B19
BC1216	BC1215	1,265	31.13	54	$577,538	$866,307	$946,637	006	B17
BC1217	BC1216	778	31.09	54	$355,197	$532,796	$582,200	006	B17
BC1236	BC1236A	126	31.00	54	$57,526	$86,289	$94,290	006	B17

City of Bryan
Wastewater Collection System Master Plan
Table 7 - 5 Relief Sewers CIP Projects For Year 2020 With 40% I/I Removed

U/S Node	D/S Node	Pipe Length (ft)	Design (5yr) Flow (cfs)	Proposed Diameter (in)	Proposed CIP Construction Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2005 Costs Basis)	Project Number	Subsystem No.
BC1236A	BC1217	608	31.07	54	$277,583	$416,375	$454,984	006	B17
BC1248	BC1236	157	30.52	54	$71,679	$107,519	$117,488	006	B17
BC2464	BC1206	1,228	36.19	66	$734,855	$1,102,283	$1,204,494	006	B19
Project 006 Total		7,661			$4,129,929	$6,194,894	$6,769,327		
Project 007									
BC1410	BC1208	702	5.28	30	$151,450	$227,175	$248,240	007	B19
BC1411	BC2471DS	55	9.66	30	$11,866	$17,799	$19,449	007	B18
BC1412	BC1411	172	9.53	30	$37,108	$55,662	$60,823	007	B18
BC1418	BC1412	923	9.41	30	$199,129	$298,694	$326,390	007	B18
BC1419	BC1418	486	9.29	30	$104,851	$157,277	$171,860	007	B18
BC1423	BC1419	83	9.13	30	$17,906	$26,859	$29,350	007	B18
BC1424	BC1423	159	8.97	27	$31,041	$46,562	$50,879	007	B18
BC1425	BC1424	867	8.81	27	$169,259	$253,889	$277,431	007	B18
BC1426	BC1425	194	8.64	27	$37,872	$56,808	$62,076	007	B18
BC1429	BC1426	80	8.46	27	$15,618	$23,427	$25,599	007	B18
BC1450	BC1429	373	8.28	27	$72,818	$109,227	$119,355	007	B18
BC1451	BC1450	63	8.10	27	$12,299	$18,449	$20,159	007	B18
BC1480	BC1451	492	7.91	27	$96,049	$144,074	$157,433	007	B18
BC1481	BC1480	366	7.72	27	$71,452	$107,178	$117,116	007	B18
BC2471DS	BC1410	588	5.72	30	$126,856	$190,284	$207,928	007	B18
Project 007 Total		5,603			$1,155,574	$1,733,361	$1,894,090		
Project 008									
BC1482	BC1481	223	7.52	24	$35,543	$53,315	$58,258	008	B18
BC1483	BC1482	566	7.32	24	$90,209	$135,314	$147,861	008	B18
BC1494	BC1483	155	7.10	24	$24,705	$37,058	$40,494	008	B18

City of Bryan
Wastewater Collection System Master Plan
Table 7 - 5 Relief Sewers CIP Projects For Year 2020 With 40% I/I Removed

U/S Node	D/S Node	Pipe Length (ft)	Design (5yr) Flow (cfs)	Proposed Diameter (in)	Proposed CIP Construction Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2005 Costs Basis)	Project Number	Subsystem No.
BC1504	BC1494	254	6.89	24	$40,484	$60,726	$66,357	008	B18
BC1518	BC1504	322	6.68	24	$51,321	$76,982	$84,120	008	B18
BC1519	BC1518	474	6.46	24	$75,548	$113,322	$123,830	008	B18
BC1520	BC1519	164	3.89	18	$21,598	$32,397	$35,401	008	B18
BC1522	BC1520	174	3.62	18	$22,914	$34,371	$37,558	008	B18
BC1523	BC1522	67	3.36	18	$8,824	$13,236	$14,463	008	B18
BC1524	BC1523	153	3.09	18	$20,149	$30,224	$33,026	008	B18
BC1530	BC1524	58	2.83	18	$7,637	$11,456	$12,518	008	B18
BC1531	BC1530	171	2.56	18	$22,519	$33,779	$36,911	008	B18
BC1532	BC1531	227	2.29	12	$24,027	$36,041	$39,382	008	B18
BC1533	BC1532	312	2.03	12	$33,025	$49,538	$54,131	008	B18
BC1534	BC1533	271	1.76	12	$28,686	$43,029	$47,019	008	B18
BC1536	BC1534	169	1.49	12	$17,889	$26,834	$29,322	008	B18
BC1537	BC1536	402	1.23	12	$42,551	$63,827	$69,745	008	B18
Project 008 Total		4,162			$567,629	$851,444	$930,395		
Project 009									
BC1259	BC1248	518	30.47	54	$236,495	$354,743	$387,637	009	B17
BC1267	BC1259	65	30.39	54	$29,676	$44,514	$48,642	009	B17
BC1268	BC1267	354	30.33	54	$161,620	$242,430	$264,910	009	B17
BC1269	BC1268	77	30.24	54	$35,154	$52,731	$57,621	009	B17
BC1272	BC1269	709	30.17	54	$323,695	$485,543	$530,565	009	B17
BC1275	BC1272	182	30.05	54	$83,092	$124,638	$136,195	009	B17
BC1276	BC1275	122	29.95	54	$55,700	$83,550	$91,297	009	B17
BC1286	BC1276	269	29.84	54	$122,812	$184,218	$201,300	009	B17
BC1288	BC1286	282	29.74	54	$128,747	$193,121	$211,028	009	B17
BC1290	BC1288	281	29.65	54	$128,290	$192,435	$210,279	009	B17

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BC1293	BC1290	295	29.54	54	$134,683	$202,025	$220,758	009	B17
BC1295	BC1293	424	29.44	54	$193,578	$290,367	$317,292	009	B17
BC1302	BC1295	400	29.33	54	$182,621	$273,932	$299,332	009	B17
BC1303	BC1302	700	29.29	54	$319,586	$479,379	$523,830	009	B17
Project 009 Total		4,678			$2,135,749	$3,203,624	$3,500,686		
Project 010									
BC1648	BC1303	644	12.50	30	$138,938	$208,407	$227,732	010	B17
BC1649	BC1648	1,014	12.43	30	$218,762	$328,143	$358,571	010	B17
BC1650	BC1649	681	12.10	30	$146,920	$220,380	$240,815	010	B17
BC1651	BC1650	91	11.93	30	$19,633	$29,450	$32,180	010	B17
BC1653	BC1651	2,072	11.74	30	$447,017	$670,526	$732,701	010	B17
BC1654	BC1653	1,300	11.83	30	$280,464	$420,696	$459,706	010	B17
BC1655	BC1654	348	11.71	30	$75,078	$112,617	$123,060	010	B17
BC1705	BC1655	378	11.53	30	$81,550	$122,325	$133,668	010	B17
BC1706	BC1705	726	11.36	30	$156,628	$234,942	$256,727	010	B17
BC1707	BC1706	250	11.23	30	$53,935	$80,903	$88,404	010	B17
Project 010 Total		7,504			$1,618,925	$2,428,388	$2,653,565		
Project 011									
BC1708	BC1707	144	11.04	27	$28,112	$42,168	$46,078	011	B16
BC1709	BC1708	214	10.42	27	$41,777	$62,666	$68,476	011	B16
BC1710	BC1709	192	9.82	27	$37,482	$56,223	$61,436	011	B16
BC1711	BC1710	34	9.24	27	$6,637	$9,956	$10,879	011	B16
BC1733	BC1711	260	8.63	27	$50,757	$76,136	$83,195	011	B16
BC1743	BC1733	110	8.07	27	$21,475	$32,213	$35,199	011	B16
BC1744	BC1743	980	7.57	27	$191,318	$286,977	$313,588	011	B15

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BC1788	BC1744	433	7.32	27	$84,531	$126,797	$138,554	011	B15
BC1834	BC1788	254	7.03	27	$49,587	$74,381	$81,278	011	B15
BC1835	BC1834	160	6.75	27	$31,235	$46,853	$51,197	011	B15
BC1836	BC1835	128	6.46	21	$18,431	$27,647	$30,210	011	B15
BC1837	BC1836	295	6.16	21	$42,479	$63,719	$69,627	011	B15
BC1838	BC1837	133	5.86	21	$19,151	$28,727	$31,390	011	B15
BC1839	BC1838	299	5.56	21	$43,055	$64,583	$70,571	011	B15
BC1840	BC1839	312	5.26	21	$44,927	$67,391	$73,639	011	B15
BC1849	BC1840	336	4.94	21	$48,383	$72,575	$79,304	011	B15
BC1850	BC1849	190	4.61	21	$27,359	$41,039	$44,844	011	B15
BC1851	BC1850	377	4.29	21	$54,286	$81,429	$88,980	011	B15
BC1852	BC1851	71	3.94	21	$10,223	$15,335	$16,756	011	B15
BC1853	BC1852	288	3.56	18	$37,928	$56,892	$62,167	011	B15
BC1854	BC1853	122	3.18	18	$16,066	$24,099	$26,334	011	B15
BC1856	BC1854	256	2.79	15	$31,189	$46,784	$51,122	011	B15
BC1862	BC1856	212	2.40	15	$25,830	$38,745	$42,338	011	B15
BC1863	BC1862	268	2.01	15	$32,652	$48,978	$53,520	011	B15
BC1864	BC1863	210	1.61	15	$25,585	$38,378	$41,936	011	B15
BC1865	BC1864	379	1.22	12	$40,117	$60,176	$65,755	011	B15
Project 011 Total		6,657			$1,060,572	$1,590,858	$1,738,373		
Project 012									
BC1304	BC1303	555	19.09	42	$172,162	$258,243	$282,189	012	B17
BC1305	BC1304	910	18.99	42	$282,284	$423,426	$462,689	012	B17
BC1306	BC1305	863	18.86	42	$267,704	$401,556	$438,791	012	B17
BC1307	BC1306	597	18.66	42	$185,191	$277,787	$303,545	012	B17
BC1308	BC1307	360	18.18	36	$89,040	$133,560	$145,945	012	B17

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BC1309	BC1308	333	18.04	36	$82,362	$123,543	$134,999	012	B17
BC1310	BC1309	166	17.89	36	$41,057	$61,586	$67,296	012	B17
BC1311	BC1310	434	17.74	36	$107,343	$161,015	$175,945	012	B17
BC1312	BC1311	1,059	17.60	36	$261,926	$392,889	$429,320	012	B17
BC1313	BC1312	675	17.49	36	$166,951	$250,427	$273,648	012	B17
BC1314	BC1313	93	17.32	36	$23,002	$34,503	$37,702	012	B17
Project 012 Total		6,045			$1,679,022	$2,518,533	$2,752,069		
Project 013									
BC1315	BC1314	464	17.15	30	$100,104	$150,156	$164,080	013	B17
BC1316	BC1315	457	16.99	30	$98,594	$147,891	$161,604	013	B17
BC1317	BC1316	356	16.82	30	$76,803	$115,205	$125,887	013	B14
BC1318	BC1317	779	9.77	27	$152,079	$228,119	$249,271	013	B14
BC1319	BC1318	743	9.57	27	$145,050	$217,575	$237,750	013	B14
BC1320	BC1319	615	9.34	27	$120,062	$180,093	$196,792	013	B14
Project 013 Total		3,414			$692,692	$1,039,038	$1,135,385		
Project 014									
BC1321	BC1320	523	9.13	27	$102,102	$153,153	$167,354	014	B14
BC1322	BC1321	256	8.90	27	$49,977	$74,966	$81,917	014	B14
BC1328	BC1322	1,303	6.77	24	$207,675	$311,513	$340,398	014	B14
BC1330	BC1328	608	6.58	24	$96,904	$145,356	$158,834	014	B14
BC1331	BC1330	249	6.35	24	$39,686	$59,529	$65,049	014	B14
BC1332	BC1331	263	6.10	24	$41,918	$62,877	$68,707	014	B14
BC1333	BC1332	263	5.86	24	$41,918	$62,877	$68,707	014	B14
BC1336	BC1333	522	5.61	24	$83,198	$124,797	$136,369	014	B14
BC1338	BC1336	286	5.35	24	$45,583	$68,375	$74,715	014	B14

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BC1339	BC1338	232	5.09	21	$33,407	$50,111	$54,757	014	B14
BC1340	BC1339	36	4.84	21	$5,184	$7,776	$8,497	014	B14
BC1369	BC1368	341	2.94	18	$44,906	$67,359	$73,605	014	B14
BC1384	BC1369	598	2.66	18	$78,751	$118,127	$129,080	014	B14
BC1385	BC1384	598	2.38	18	$78,751	$118,127	$129,080	014	B14
BC1386	BC1385	542	2.09	18	$71,377	$107,066	$116,993	014	B14
Project 014 Total		6,620			$1,021,337	$1,532,006	$1,674,064		
Project 015									
BC0444	BC0443	423	28.53	48	$158,309	$237,464	$259,483	015	B23
BC0445	BC0444	814	28.53	48	$304,643	$456,965	$499,337	015	B23
BC0446	BC0445	440	28.52	48	$164,672	$247,008	$269,912	015	B23
BC0447	BC0446	416	28.50	48	$155,690	$233,535	$255,190	015	B23
BC0448DP	BC0447	552	28.48	48	$206,588	$309,882	$338,616	015	B23
BC0449	BC0448DP	301	28.45	48	$112,651	$168,977	$184,645	015	B23
BC0451	BC2514DP	120	28.77	54	$54,787	$82,181	$89,801	015	B23
BC0452	BC0451	145	28.78	54	$66,199	$99,299	$108,506	015	B23
BC0453	BC0452	209	28.75	54	$95,419	$143,129	$156,400	015	B23
BC0480	BC0453	1,034	28.73	42	$320,749	$481,124	$525,737	015	B23
BC2509	BC0449	39	13.58	30	$8,415	$12,623	$13,793	015	B23
BC2510DP	BC2509	379	13.58	30	$81,766	$122,649	$134,022	015	B23
Project 015 Total		4,872			$1,729,888	$2,594,832	$2,835,443		
Project 016									
BC0908	BC0908B	703	23.94	60	$354,991	$532,487	$581,862	016	B23
BC0908B	BC0480	659	23.97	60	$332,773	$499,160	$545,445	016	B23
BC0909	BC0908	345	23.89	60	$174,214	$261,321	$285,553	016	B23

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BC0912	BC0909	296	23.84	60	$149,470	$224,205	$244,995	016	B23
BC0915	BC0912	175	23.78	60	$88,369	$132,554	$144,845	016	B23
BC0916A	BC0916B	171	23.68	60	$86,349	$129,524	$141,534	016	B23
BC0916B	BC0915	125	23.73	60	$63,121	$94,682	$103,461	016	B23
BC0917	BC0916A	187	23.63	60	$94,428	$141,642	$154,776	016	B23
BC0921	BC0917	169	23.57	48	$63,249	$94,874	$103,671	016	B23
BC0922	BC0921	232	23.52	48	$86,827	$130,241	$142,317	016	B23
BC0923	BC0922	169	23.46	48	$63,249	$94,874	$103,671	016	B23
BC0924	BC0923	177	23.41	42	$54,905	$82,358	$89,994	016	B23
BC0925	BC0924	688	23.36	42	$213,418	$320,127	$349,811	016	B23
BC0935	BC0925	177	23.31	42	$54,905	$82,358	$89,994	016	B23
BC0936	BC0935	91	14.43	36	$22,508	$33,762	$36,893	016	B23
Project 016 Total		4,364			$1,902,776	$2,854,164	$3,118,822		
Project 017									
BC0728	BC0729	436	1.33	15	$53,120	$79,680	$87,068	017	B23
BC0729	BC0730DP	737	1.46	15	$89,792	$134,688	$147,177	017	B23
BC0731	BC0731A	320	1.87	15	$38,988	$58,482	$63,905	017	B23
BC0731A	BC0762	215	3.11	15	$26,195	$39,293	$42,936	017	B23
BC0732	BC0731	297	1.68	12	$31,437	$47,156	$51,528	017	B23
BC0762	BC0932	173	10.72	33	$40,055	$60,083	$65,654	017	B23
BC0763DP	BC0762	219	8.42	33	$50,707	$76,061	$83,113	017	B23
BC0764	BC0763DP	401	10.78	33	$92,847	$139,271	$152,185	017	B28
BC0765	BC0764	562	10.62	30	$121,247	$181,871	$198,735	017	B28
BC0927	BC0935	561	11.87	33	$129,892	$194,838	$212,905	017	B23
BC0928	BC0927	551	11.82	33	$127,578	$191,367	$209,112	017	B23
BC0929	BC0928	202	11.72	33	$46,770	$70,155	$76,660	017	B23

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BC0930	BC0929	266	11.63	33	$61,589	$92,384	$100,950	017	B23
BC0931	BC0930	87	10.92	33	$20,143	$30,215	$33,016	017	B23
BC0932	BC0931	162	10.82	33	$37,509	$56,264	$61,481	017	B23
Project 017 Total		5,189			$967,869	$1,451,804	$1,586,425		
Project 018									
BC0766	BC0765	828	10.49	27	$161,645	$242,468	$264,951	018	B28
BC0768	BC0766	622	10.34	27	$121,429	$182,144	$199,033	018	B28
BC0769	BC0768	342	10.13	27	$66,767	$100,151	$109,437	018	B28
BC0770	BC0769	243	9.91	27	$47,439	$71,159	$77,757	018	B28
BC0771	BC0770	429	9.69	27	$83,750	$125,625	$137,274	018	B28
BC0772	BC0771	271	9.46	27	$52,906	$79,359	$86,718	018	B28
BC0773	BC0772	807	8.73	27	$157,545	$236,318	$258,231	018	B28
BC0774	BC0773	160	8.50	27	$31,235	$46,853	$51,197	018	B28
BC0775	BC0774	503	8.22	27	$98,197	$147,296	$160,954	018	B28
BC0779	BC0775	425	7.96	24	$67,738	$101,607	$111,029	018	B28
BC0782	BC0779	291	7.69	24	$46,380	$69,570	$76,021	018	B28
BC0788	BC0787	243	3.31	18	$32,001	$48,002	$52,453	018	B28
BC2041	BC0787	785	3.36	18	$103,377	$155,066	$169,444	018	B28
BC2052	BC2041	1,086	3.26	18	$143,017	$214,526	$234,418	018	B28
BC2053	BC2052	382	3.06	18	$50,306	$75,459	$82,456	018	B28
BC2054	BC2053	308	2.83	18	$40,561	$60,842	$66,483	018	B28
Project 018 Total		7,725			$1,304,293	$1,956,440	$2,137,854		
Project 019									
BC0852	BC0942	862	4.01	24	$137,387	$206,081	$225,190	019	B23
BC0853	BC0852	66	1.56	15	$8,042	$12,063	$13,182	019	B27

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BC0854	BC0853	153	1.41	15	$18,641	$27,962	$30,554	019	B27
BC0855	BC0854	49	1.25	15	$5,969	$8,954	$9,784	019	B27
BC0856	BC0855	212	1.10	12	$22,440	$33,660	$36,781	019	B27
Project 019 Total		1,342			$192,479	$288,719	$315,491		
Project 020									
BC0941	BC2483DP	264	14.03	33	$61,126	$91,689	$100,191	020	B23
BC0942	BC0941	371	14.00	30	$80,040	$120,060	$131,193	020	B23
BC1964	BC0942	160	11.03	30	$34,519	$51,779	$56,580	020	B23
BC1965	BC1964	363	11.01	30	$78,315	$117,473	$128,365	020	B23
BC1965A	BC1965	151	10.97	30	$32,578	$48,867	$53,398	020	B23
BC1966	BC1965A	274	10.94	30	$59,113	$88,670	$96,892	020	B23
BC1970	BC1966	315	10.91	30	$67,959	$101,939	$111,391	020	B23
BC1974	BC1970	309	10.87	30	$66,664	$99,996	$109,268	020	B23
BC2017	BC2018	706	10.82	30	$152,313	$228,470	$249,655	020	B23
BC2018	BC1974	300	10.84	30	$64,723	$97,085	$106,087	020	B23
Project 020 Total		3,213			$697,350	$1,046,025	$1,143,020		
Project 021									
BC2024	BC2020	130	2.55	18	$17,120	$25,680	$28,061	021	B23
BC2025	BC2024	158	2.50	18	$20,806	$31,209	$34,103	021	B23
BC2028	BC2025	389	2.45	18	$51,228	$76,842	$83,967	021	B23
BC2029	BC2489DP	130	1.80	18	$17,120	$25,680	$28,061	021	B26
BC2030	BC2029	275	1.63	18	$36,215	$54,323	$59,360	021	B26
BC2031	BC2030	304	1.46	18	$40,033	$60,050	$65,618	021	B26
BC2036	BC2495DP	78	1.13	15	$9,503	$14,255	$15,576	021	B26
BC2112	BC2036	430	0.95	15	$52,389	$78,584	$85,870	021	B26

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BC2113DS	BC2112	269	0.78	15	$32,774	$49,161	$53,720	021	B26
BC2114	BC2113DS	232	1.84	15	$28,265	$42,398	$46,329	021	B26
BC2131	BC2114	156	1.66	15	$19,006	$28,509	$31,153	021	B26
BC2135	BC2131	356	1.49	15	$43,373	$65,060	$71,092	021	B26
BC2135A	BC2135	453	1.30	15	$55,191	$82,787	$90,463	021	B26
BC2489DP	BC2028	240	2.39	18	$31,606	$47,409	$51,805	021	B26
BC2493DP	BC2031	235	1.29	18	$30,948	$46,422	$50,727	021	B26
Project 021 Total		3,835			$485,577	$728,366	$795,905		
Project 022									
BC2251	BC2178	650	5.19	27	$126,896	$190,344	$207,994	022	B31
BC2252	BC2251	480	5.03	27	$93,707	$140,561	$153,594	022	B31
BC2253	BC2252	323	4.84	27	$63,058	$94,587	$103,358	022	B31
BC2254	BC2253	60	4.66	27	$11,713	$17,570	$19,199	022	B31
Project 022 Total		1,513			$295,374	$443,061	$484,145		
Project 023									
BC0484	BC0488	40	4.65	27	$7,810	$11,715	$12,801	023	B32
BC0485	BC0484	113	4.51	27	$22,061	$33,092	$36,160	023	B32
BC0487	BC0486DP	57	3.64	21	$8,208	$12,312	$13,454	023	B32
BC0488	BC0489	49	10.34	27	$9,566	$14,349	$15,680	023	B32
BC0489	BC0490	214	10.48	27	$41,777	$62,666	$68,476	023	B32
BC0490	BC0491	358	10.61	27	$69,889	$104,834	$114,554	023	B32
BC0491	BC0492	109	10.74	30	$23,516	$35,274	$38,545	023	B32
BC0492	BC0493	344	10.88	30	$74,216	$111,324	$121,647	023	B32
BC0493	BC0494	198	10.88	30	$42,717	$64,076	$70,017	023	
BC0494	BC0495	66	10.88	30	$14,239	$21,359	$23,339	023	

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BC0495	BC0553	823	10.87	30	$177,555	$266,333	$291,029	023	
BC0496	BC0487	117	2.21	21	$16,848	$25,272	$27,615	023	B32
BC0497	BC0496	339	2.04	21	$48,814	$73,221	$80,011	023	B32
BC0498	BC0497	197	1.87	21	$28,368	$42,552	$46,498	023	B30
BC0499	BC0498	681	1.83	21	$98,062	$147,093	$160,732	023	B30
BC0500A	BC0499	310	1.78	21	$44,639	$66,959	$73,167	023	B30
BC0553	BC0531DS	360	10.87	30	$77,667	$116,501	$127,303	023	
BC1019A	BC0487	144	1.26	18	$18,963	$28,445	$31,082	023	B32
Project 023 Total		4,519			$824,915	$1,237,373	$1,352,110		
Project 025									
BC0352	BC0351	52	2.25	15	$6,336	$9,504	$10,385	025	B29
BC0353	BC0352	235	2.09	15	$28,632	$42,948	$46,930	025	B29
Project 025 Total		287			$34,968	$52,452	$57,316		
Project 026									
BC0468	BC0469	410	2.82	18	$53,994	$80,991	$88,501	026	B24
BC0469	BC0470	535	3.09	18	$70,455	$105,683	$115,482	026	B24
BC0470	BC0474	470	3.36	18	$61,895	$92,843	$101,452	026	B24
BC0474	BC0475	321	3.63	18	$42,273	$63,410	$69,289	026	B24
BC0475	BC0476	335	3.89	18	$44,117	$66,176	$72,312	026	B24
BC0476	BC0477	245	4.16	18	$32,265	$48,398	$52,885	026	B24
BC0477	BC0478	84	4.42	18	$11,062	$16,593	$18,132	026	B24
BC0478	BC0479	474	4.68	18	$62,421	$93,632	$102,314	026	B24
BC0479	BC0480	208	4.94	18	$27,392	$41,088	$44,898	026	B24
BC0572	BC0571	621	4.69	24	$98,976	$148,464	$162,231	026	B22
BC0573	BC0572	757	4.56	24	$120,651	$180,977	$197,758	026	B22

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BC0574	BC0573	92	4.42	24	$14,663	$21,995	$24,034	026	B22
BC0575	BC0574	79	4.27	24	$12,591	$18,887	$20,638	026	B22
BC0576	BC0575	293	4.12	24	$46,699	$70,049	$76,544	026	B22
BC0577	BC0576	145	3.98	24	$23,111	$34,667	$37,881	026	B22
BC0578	BC0577	486	3.84	24	$77,459	$116,189	$126,962	026	B22
BC0579	BC0578	578	3.70	24	$92,122	$138,183	$150,996	026	B22
BC0580	BC0579	60	3.54	24	$9,563	$14,345	$15,675	026	B22
BC0581	BC0580	217	3.38	24	$34,585	$51,878	$56,688	026	B22
BC0582	BC0581	301	3.22	24	$47,974	$71,961	$78,634	026	B22
BC0626	BC0685	647	1.71	15	$78,827	$118,241	$129,205	026	B24
BC0683	BC0468	234	2.54	15	$28,509	$42,764	$46,729	026	B24
BC0684	BC0683	207	2.26	15	$25,220	$37,830	$41,338	026	B24
BC0685	BC0684	210	1.99	15	$25,585	$38,378	$41,936	026	B24
Project 026 Total		8,009			$1,142,409	$1,713,614	$1,872,512		
Project 101									
60010	60012	168	6.25	30	$36,244	$54,366	$59,407	101	B09
60012	60014	644	6.25	30	$138,938	$208,407	$227,732	101	B09
60014	60016	55	6.25	30	$11,866	$17,799	$19,449	101	B09
60016	60018	233	6.25	30	$50,268	$75,402	$82,394	101	B09
60018	60020	288	6.25	30	$62,134	$93,201	$101,843	101	B09
60020	SC0010	15	6.25	30	$3,237	$4,856	$5,306	101	B09
SC0003	SC0002	104	10.46	27	$20,303	$30,455	$33,278	101	B09
SC0004	SC0003	234	10.45	27	$45,682	$68,523	$74,877	101	B09
SC0005	SC0004	160	10.45	27	$31,235	$46,853	$51,197	101	B09
SC0006	SC0005	844	10.45	27	$164,768	$247,152	$270,070	101	B09
SC0007	SC0006	414	10.45	27	$80,822	$121,233	$132,475	101	B09

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SC0008	SC0007	453	10.45	27	$88,435	$132,653	$144,953	101	B09
SCLS01FM	SC0008	3,243	14.76	24	$353,462	$530,193	$579,356	101	B05_06
PS					$691,865	$1,037,798	$1,134,029		
Project 101 Total		6,855			$1,779,259	$2,668,889	$2,916,367		
Project 102									
SC0097	SC0077DP	303	5.82	24	$48,293	$72,440	$79,157	102	B09
SC0098	SC0097	298	5.77	24	$47,495	$71,243	$77,849	102	B09
SC0099	SC0098	1,224	5.73	24	$195,084	$292,626	$319,760	102	B09
SC0100	SC0099	146	5.69	24	$23,269	$34,904	$38,140	102	B10
SC0101	SC0100	303	5.46	24	$48,293	$72,440	$79,157	102	B10
SC0102	SC0101	343	5.23	24	$54,668	$82,002	$89,606	102	B10
SC0103	SC0102	942	5.00	24	$150,138	$225,207	$246,090	102	B10
SC0161	SC0165A	305	1.78	15	$37,160	$55,740	$60,909	102	B10
SC0165A	SC0168	314	2.03	18	$41,351	$62,027	$67,778	102	B10
SC0168	SC0175	152	2.28	18	$20,017	$30,026	$32,810	102	B10
SC0175	SC0176	295	2.53	18	$38,849	$58,274	$63,677	102	B10
SC0176	SC0177	311	2.78	18	$40,956	$61,434	$67,131	102	B10
SC0177	SC0178A	181	3.02	18	$23,836	$35,754	$39,069	102	B10
SC0178A	SC0103	262	3.76	18	$34,503	$51,755	$56,554	102	B10
Project 102 Total		5,379			$803,912	$1,205,868	$1,317,685		
Project 103									
SC1071	SCLS09PS	167	7.33	27	$32,603	$48,905	$53,439	103	B10
SC1072	SC1071	422	6.10	27	$82,384	$123,576	$135,035	103	B08
SC1073	SC1072	373	5.87	27	$72,818	$109,227	$119,355	103	B08
SC1074	SC1073	356	5.67	27	$69,499	$104,249	$113,915	103	B08

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SC1075	SC1074	351	5.46	27	$68,523	$102,785	$112,315	103	B08
SC1076	SC1075	350	5.25	21	$50,399	$75,599	$82,609	103	B08
SC1077	SC1076	350	5.03	21	$50,399	$75,599	$82,609	103	B08
SC1078	SC1077	500	4.81	21	$71,998	$107,997	$118,011	103	B08
SC1079	SC1078	500	4.59	21	$71,998	$107,997	$118,011	103	B08
SC1080	SC1079	500	4.37	21	$71,998	$107,997	$118,011	103	B08
SC1081	SC1080	500	4.15	18	$65,846	$98,769	$107,928	103	B08
SC1082	SC1081	500	3.92	18	$65,846	$98,769	$107,928	103	B08
SC1083	SC1082	500	3.68	18	$65,846	$98,769	$107,928	103	B08
SC1094	SC1083	432	3.44	18	$56,891	$85,337	$93,249	103	B08
SCLS09FM	SC1065	3,200	8.94	20	$293,174	$439,761	$480,539	103	B09
PS					$987,250	$1,480,875	$1,618,192		
Project 103 Total		9,001			$2,177,472	$3,266,208	$3,569,074		
Project 104									
SC0264	SC0002	1,118	8.00	30	$241,199	$361,799	$395,347	104	B09
SC0265DP	SC341BDP	465	8.30	30	$100,320	$150,480	$164,434	104	B05_06
SC341BDP	SC0264	174	7.99	30	$37,539	$56,309	$61,530	104	B09
Project 104 Total		1,757			$379,058	$568,587	$621,310		
Project 105									
SC0382	SC0310	342	9.42	30	$73,783	$110,675	$120,937	105	B05_06
SC0383	SC0382	269	9.37	30	$58,035	$87,053	$95,125	105	B05_06
SC0453DP	SC0383	1,223	9.32	30	$263,852	$395,778	$432,477	105	B05_06
SC0454	SC0453DP	45	9.90	30	$9,708	$14,562	$15,912	105	B05_06
SC0455	SC0454	745	9.83	30	$160,727	$241,091	$263,446	105	B05_06

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Project 105 Total		2,624			$566,105	$849,158	$927,897		
Project 106									
SC0732	SC0731DP	600	1.77	24	$95,629	$143,444	$156,745	106	B05_06
SC0733	SC0732	400	1.74	24	$63,753	$95,630	$104,497	106	B05_06
SC0734	SC0733	487	1.68	24	$77,618	$116,427	$127,223	106	B05_06
SC0740	SC0734	948	1.69	24	$151,093	$226,640	$247,655	106	B05_06
SC0741	SC0740	545	1.54	24	$86,864	$130,296	$142,378	106	B05_06
SC0742	SC0741	545	1.50	24	$86,864	$130,296	$142,378	106	B05_06
SC0750DP	SC0742	409	0.00	24	$65,187	$97,781	$106,847	106	B05_06
Project 106 Total		3,934			$627,008	$940,512	$1,027,723		
Project 107									
SC0760	SC0750DP	833	8.93	27	$162,620	$243,930	$266,549	107	B05_06
SC0761	SC0760	133	8.70	27	$25,964	$38,946	$42,557	107	B05_06
SC0762	SC0761	227	8.67	27	$44,316	$66,474	$72,638	107	B05_06
SC0763	SC0762	174	8.63	27	$33,969	$50,954	$55,678	107	B05_06
SC0764	SC0763	81	6.50	24	$12,910	$19,365	$21,161	107	B04
SC0765	SC0764	209	6.05	21	$30,095	$45,143	$49,328	107	B04
SC0769	SC0765	250	5.59	21	$35,999	$53,999	$59,006	107	B04
SC0770	SC0769	330	5.14	21	$47,519	$71,279	$77,888	107	B04
SC0771	SC0770	172	4.68	21	$24,768	$37,152	$40,597	107	B04
SC0774	SC0771	310	4.22	21	$44,639	$66,959	$73,167	107	B04
SC0777	SC0774	310	3.77	18	$40,825	$61,238	$66,916	107	B04
SC0780	SC0777	301	3.31	18	$39,638	$59,457	$64,970	107	B04
SC0783	SC0780	649	2.85	18	$85,467	$128,201	$140,088	107	B04
SC0803	SC0783	506	2.38	15	$61,649	$92,474	$101,048	107	B04

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SC0804	SC0803	365	1.91	15	$44,469	$66,704	$72,889	107	B04
SC0806	SC0804	281	1.43	15	$34,236	$51,354	$56,116	107	B04
Project 107 Total		5,131			$769,083	$1,153,625	$1,260,597		
Project 108									
SC1006	SC1024	42	3.78	18	$5,532	$8,298	$9,067	108	B05_06
SC1024	SC1025	362	3.57	18	$47,672	$71,508	$78,139	108	B05_06
SC1025	SC1026	362	-5.90	24	$57,696	$86,544	$94,569	108	B05_06
SC1026	SCLS07PS	148	-5.62	24	$23,588	$35,382	$38,663	108	B05_06
Project 108 Total		914			$134,488	$201,732	$220,438		
Project 109									
SC0512DP	SC9909	370	1.42	12	$39,165	$58,748	$64,195	109	B05_6
SC0656	SC0461DP	496	0.48	15	$60,429	$90,644	$99,049	109	B05_06
SC9901	SC0371DP	604	6.86	24	$96,267	$144,401	$157,790	109	B05_6
SC9902	SC9901	642	6.86	24	$102,323	$153,485	$167,717	109	B05_6
SC9903	SC9902	571	6.86	24	$91,007	$136,511	$149,169	109	B05_6
SC9904	SC9903	379	6.86	24	$60,405	$90,608	$99,009	109	B05_6
SC9905	SC9904	221	6.80	24	$35,224	$52,836	$57,735	109	B05_6
SC9906	SC9905	390	6.74	24	$62,159	$93,239	$101,884	109	B05_6
SC9907	SC9906	421	6.68	24	$67,100	$100,650	$109,983	109	B05_6
SC9908	SC9907	523	6.62	24	$83,357	$125,036	$136,630	109	B05_6
SC9909	SC9908	182	6.50	24	$29,008	$43,512	$47,547	109	B05_6
Project 109 Total		4,799			$726,444	$1,089,666	$1,190,707		
Project 110									

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SC0514	SC0514A	335	4.43	18	$44,117	$66,176	$72,312	110	B07
SC0514A	SC0513	338	4.76	18	$44,512	$66,768	$72,959	110	B07
SC0515	SC0514	325	4.10	18	$42,799	$64,199	$70,151	110	B07
SC0524	SC0515	995	3.77	18	$131,033	$196,550	$214,775	110	B07
SC0547	SC0524	287	3.45	18	$37,795	$56,693	$61,949	110	B07
SC0550	SC0547	329	3.08	18	$43,327	$64,991	$71,017	110	B07
SC0551	SC0550	201	2.71	15	$24,489	$36,734	$40,140	110	B07
SC0552	SC0551	209	2.33	15	$25,463	$38,195	$41,736	110	B07
Project 110 Total		3,019			$393,535	$590,303	$645,039		
Project 111									
SC1044	SC1043	350	7.55	27	$68,329	$102,494	$111,997	111	B09
Project 111 Total		350			$68,329	$102,494	$111,997		
Project 201									
TC0044A	TC0044	164	4.65	21	$23,615	$35,423	$38,707	201	
TC0045	TC0044A	175	4.65	21	$25,199	$37,799	$41,303	201	B12
TC0046	TC0045	182	4.54	21	$26,207	$39,311	$42,956	201	B12
TC0047	TC0046	115	4.43	21	$16,559	$24,839	$27,142	201	B12
TC0048	TC0047	658	4.31	21	$94,749	$142,124	$155,302	201	B12
TC0049	TC0048	240	4.20	21	$34,558	$51,837	$56,644	201	B12
TC0055	TC0049	529	4.08	21	$76,175	$114,263	$124,858	201	B12
TC0056	TC0055	508	3.95	21	$73,150	$109,725	$119,899	201	B12
TC0057	TC0056	107	3.81	21	$15,407	$23,111	$25,253	201	B12
TC0060	TC0057	418	3.67	21	$60,191	$90,287	$98,658	201	B12
TC0064	TC0060	503	3.53	21	$72,429	$108,644	$118,718	201	B12
TC0065	TC0064	126	3.42	18	$16,594	$24,891	$27,199	201	B12

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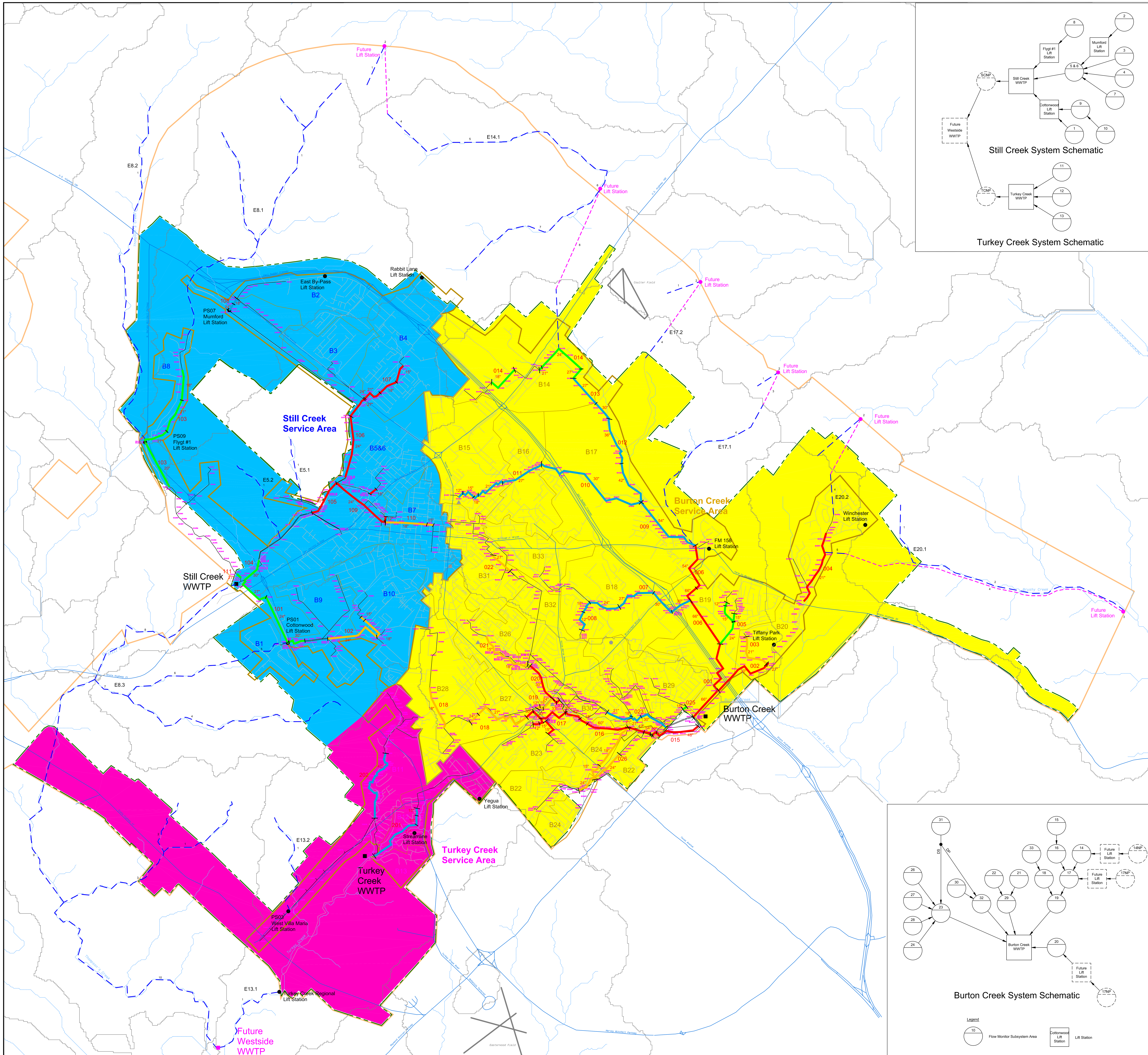
TC0069	TC0065	315	3.26	18	$41,483	$62,225	$67,994	201	B12
TC0070	TC0069	151	3.09	18	$19,886	$29,829	$32,595	201	B12
TC0073	TC0070	186	2.92	15	$22,661	$33,992	$37,143	201	B12
TC0075	TC0073	163	2.76	15	$19,859	$29,789	$32,551	201	B12
TC0077	TC0075	123	2.59	15	$14,986	$22,479	$24,563	201	B12
Project 201 Total		4,663			$653,708	$980,562	$1,071,487		
Project 202									
TC0183	TC0177	124	7.39	42	$38,465	$57,698	$63,048	202	B11
TC0186	TC0183	903	7.37	42	$280,112	$420,168	$459,129	202	B11
TC0187	TC0186	205	7.43	42	$63,592	$95,388	$104,233	202	B11
TC0192	TC0187	201	7.47	42	$62,350	$93,525	$102,197	202	B11
TC0193	TC0192	206	7.50	42	$63,901	$95,852	$104,740	202	B11
TC0194	TC0193	138	7.47	42	$42,807	$64,211	$70,165	202	B11
TC0195	TC0194	490	7.41	42	$151,999	$227,999	$249,140	202	B11
TC0196	TC0195	224	7.34	42	$69,485	$104,228	$113,892	202	B11
TC0197	TC0196	135	7.28	42	$41,877	$62,816	$68,640	202	B11
TC0198	TC0197	103	7.21	42	$31,951	$47,927	$52,371	202	B11
TC0199	TC0198	117	7.14	42	$36,293	$54,440	$59,488	202	B11
TC0200	TC0199	164	7.06	42	$50,873	$76,310	$83,385	202	B11
TC0211	TC0200	286	6.99	42	$88,718	$133,077	$145,417	202	B11
TC0212	TC0211	111	6.91	42	$34,432	$51,648	$56,437	202	B11
TC0213	TC0212	158	6.84	42	$49,012	$73,518	$80,335	202	B11
TC0214	TC0213	166	6.76	42	$51,493	$77,240	$84,402	202	B11
TC0215	TC0214	202	6.66	42	$62,661	$93,992	$102,707	202	B11
TC0216	TC0215	166	6.57	42	$51,493	$77,240	$84,402	202	B11
TC0217	TC0216	93	6.48	42	$28,848	$43,272	$47,284	202	B11

City of Bryan
Wastewater Collection System Master Plan
Table 7 - 5 Relief Sewers CIP Projects For Year 2020 With 40% I/I Removed

U/S Node	D/S Node	Pipe Length (ft)	Design (5yr) Flow (cfs)	Proposed Diameter (in)	Proposed CIP Construction Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2002 Cost Basis)	Proposed CIP Capital Costs (2005 Costs Basis)	Project Number	Subsystem No.
TC0218	TC0217	221	6.39	42	$68,555	$102,833	$112,368	202	B11
TC0219	TC0218	120	6.29	42	$37,225	$55,838	$61,015	202	B11
TC0220	TC0219	141	6.20	42	$43,739	$65,609	$71,692	202	B11
TC0221	TC0220	226	6.09	42	$70,106	$105,159	$114,910	202	B11
TC0222	TC0221	398	6.00	42	$123,460	$185,190	$202,362	202	B11
Project 202 Total		5,298			$1,643,447	$2,465,171	$2,693,758		
Total		**172,290**			**$40,391,320**	**$60,586,980**	**$66,205,029**		



City of Bryan, Texas
Wastewater Collection System Master Plan
2002

SCALE IN MILES

Legend

- B18 Subsystem Boundaries
- Existing Service Area Boundaries
- Existing Analyzed Areas
- Existing City Limits
- 2020 Service Area
- Non-Modeled Pipes
- Modeled Pipe
- Existing Lift Station
- Wastewater Treatment Plant
- Streams
- Ridge Lines
- Major Roads and Highways
- Police Department
- School
- Fire Station

CIP Information

- 2005 CIP Projects
- 2010 CIP Projects
- 2015 CIP Projects
- 2020 CIP Projects
- 001 Relief Sewer Project Number
- 24" Relief Sewer Pipe Size
- Potential Sewer Expansion - Wastewater Treatment Plant
- Potential Sewer Expansion - Lift Station
- Potential Sewer Extension - Force Main
- Potential Sewer Extension - Gravity

WASTEWATER CIP MASTER PLAN

BLACK & VEATCH CORPORATION

Exhibit 7-1

8

Section Eight

Conclusions and Recommendations

8.0 Conclusions and Recommendations

8.1 Conclusions

8.1.1 Collection System

The results of the review of The City of Bryan wastewater collection system indicate that there are system wide capacity concerns. This is of particular importance with regard to the proposed CMOM regulations previously noted.

Inflow and Infiltration (I/I) is prevalent throughout the entire existing system with the primary component being inflow. Exhibit 6-1 shows existing sewers larger than 10 inches in diameter whose capacities are either currently exceeded or are anticipated to be exceeded by peak flows. It is not cost-effective to construct a wastewater conveyance system and treatment facilities that handle the magnitude of I/I that is available to enter the existing system. Therefore it is imperative that a comprehensive I/I reduction program be successfully implemented. For purposes of this evaluation, a goal of 40 percent I/I reduction was used for evaluation of improvements.

I/I cannot be adequately targeted for removal without undertaking a separate Inflow/Infiltration reduction analyses. As noted in Section III.I.4.a of the proposed CMOM rule "Trying to fix complex, wet weather collection system problems without adequately evaluating the collection system can result in pursuing inappropriate solutions that are not the most cost-effective and that may even lead to overflow problems in other parts of the collection system. In addition, a detailed evaluation of the collection system can dramatically reduce remediation costs by providing information on the causes of the SSO problem that allows selection of the most cost-effective solutions."

Based on data reviewed, growth is projected both within and outside the existing service areas. Growth in areas not currently served by the existing system will require a coordinated approach to the extension of existing system and potentially separate systems that cannot be effectively added to the existing systems.

8.1.2 Burton Creek Wastewater Treatment Plant

Based on plant data provided by The City of Bryan, the capacity analysis of the Burton Creek Wastewater Treatment Plant indicated the plant could treat 5.4 mgd during maximum month mass loading conditions. The current permitted capacity is 8.0 mgd. The capacity of the plant is primarily limited by the primary clarifier, the trickling filter and aeration basin blower capacities.

Based on plant capacities developed in the evaluation, the average daily flow exceeded 90 percent of the evaluated capacity for at least three consecutive months. Based on TCEQ guidelines, facility improvements should be in construction. However, based on plant permitted flows, the average flow is below 75 percent.

Based on staff input, the peak flows through the plant can exceed plant hydraulic capacity and result in solids washout. A peak flow of 13.8 mgd should be supported by the existing process units, based on typical hydraulic loading rates. However if 13.8 mgd flows cause solids washout, additional hydraulic evaluation of the plant, including developing a plant hydraulic profile and computational fluid dynamic modeling of the final clarifiers would be warranted. Peak flows in excess of the plant hydraulic capacity must be reduced.

8.1.3 Still Creek Wastewater Treatment Plant

Based on plant data provided by The City of Bryan, the capacity analysis of the Still Creek Wastewater Treatment Plant indicated the plant could treat 2.5 mgd during maximum month mass loading conditions. The current permitted capacity is 4.0 mgd. The capacity of the plant is primarily limited by primary clarifier (at peak day flows) and installed blower capacity.

Based on plant capacities developed in this evaluation, average daily flows exceeded 75 percent of the evaluated capacity for at least three consecutive months. Based on TCEQ guidelines, facility improvements should be in planning and design.

However, based on plant permitted flows, the average flow is below 75 percent. Based on staff input, the peak flows through the plant can exceed plant hydraulic capacity and result in solids washout. A peak flow of 11.4 mgd should be supported by the existing process units, based on typical hydraulic loading rates. However if 11.4 mgd flows cause solids washout, additional hydraulic evaluation of the plant, including developing a plant hydraulic profile and computational fluid dynamic modeling of the final clarifiers would be warranted. Peak flows in excess of plant hydraulic capacity must be reduced.

8.1.4 Turkey Creek Wastewater Treatment Plant

Based on plant data provided by The City of Bryan, the capacity analysis of the Turkey Creek Wastewater Treatment Plant indicated the plant could treat 0.65 mgd during maximum month mass loading conditions. The current permitted capacity is 0.75 mgd. The capacity of the plant is primarily limited by aeration basin/final clarifier process and dechlorination feed rate.

Based on plant capacities and permitted capacities, average daily flows exceed 75 percent of the evaluated capacity for at least three consecutive months. Based on TCEQ guidelines, facility improvements should be in planning and design. The existing site with surrounding development provides virtually no potential for expansion.

8.2 Recommendations

Wastewater Collection System Capital Improvements recommended for completion are shown on Exhibits 7-1 and 7-2 and are tabulated in Tables 7-1 thru 7-5. These recommendations are based on The City of Bryan achieving a 40% reduction in I/I allowable to enter the collection system. Therefore, it is necessary that The City of Bryan take an aggressive approach to reducing I/I within the system.

8.2.1 Priority Conveyance System Projects

As shown on Exhibits 7-1 and 7-2 and accompanying tables, the list of capital improvements recommended to address The City of Bryan's wastewater collection system needs is extensive. While the list is prioritized, over time numerous factors will influence and reprioritize these improvements.

The items identified as Relief Sewers are improvements to the existing collection system including additional capacity for anticipated growth up to the year 2020. This is based on successfully reducing inflow and infiltration entering the system by 40%.

The items identified as Sewer Extensions are future extensions of the existing collection system to accommodate growth. These extensions are based on ultimate development even beyond year 2020. These extensions may be reduced depending on timing of their implementation and various factors (growth projections, financial considerations, etc.) at the time of their implementation.

The scope, timing and opinion of probable costs for all projects are planning level only. Successful completion of an Inflow and Infiltration (I/I) reduction program, field surveying, and preliminary and final design are required prior to construction of any project.

8.2.2 Inflow and Infiltration Reduction Program

It is recommended that The City of Bryan aggressively undertake an I/I reduction program to primarily reduce the inflow identified in the data reviewed during the preparation of this Master Plan. While it has been concluded that system wide concerns exist within all three basins – Burton Creek, Still Creek and Turkey Creek, it is apparent that the Burton Creek Basin exhibits the greatest concerns as shown in Figure 2-8.

Therefore The City of Bryan may consider addressing the concerns in the Burton Creek Basin first and then move on to the remaining two basins. This method will ultimately address the concerns of the entire system, yet spread the work and associated costs over a period of time.

The program consists of various phases. During Phase I, specific service area basin needs are defined and any additional work required to meet project objectives is established. This step will quantify wet weather flow concerns in the selected I/I reduction area and develop a plan of action to address those concerns identified in the Master Plan. Phase II includes all subsequent work and could consist of field inspection, survey, design, construction, further detailed analysis, and related tasks. Phase III includes post-rehabilitation monitoring to determine the success of the I/I reduction program activities. It is anticipated that the following will assist The City of Bryan in executing the System Evaluation and Capacity Assurance Plan as previously discussed.

8.2.2.1 Phase I—Problem Definition

Phase I will include a surface reconnaissance program, and evaluation of system capacity relative to peak wet weather flows as identified in the Master Plan and an evaluation of the cost-effectiveness of any subsequent tasks. Specific tasks are summarized in the following paragraphs.

8.2.2.1.1 Task 1. Review of Background Data

Based on recommendations of the Master Plan, previous reports and documents relating to the study area should be reviewed. This includes records of backups and overflows, previous records and internal television records which may help in defining system needs. Obvious corrections not requiring further analysis could then commence.

8.2.2.1.2 Task 2. Flow and Rainfall Monitoring

For selected I/I concern areas identified in Phase I, further flow monitoring may be justified. This task would conduct flow and rainfall monitoring to provide the information necessary to properly evaluate system response under current conditions. This would require a plan including a schedule for meter installation, periodic calibrations, and data collection. The number of flowmeters and rain gauges needed would depend on the area and degree of further analysis required. These flowmeters and rainfall gauges could be permanently installed for use in the initial short-term monitoring, for the post-rehabilitation monitoring and ultimately for continuous monitoring to assist

The City of Bryan in meeting the proposed requirement for "continued monitoring, assessment and adjustment of implemented measures".

For the short-term I/I detailed analysis, a 90-day monitoring period should be initiated during the wet season for purposes of developing flow parameters. Monitoring needs to be performed under dry and wet weather conditions such that a minimum of three rainfall events of various intensities are measured. From this data, further costs saving measures can be determined prior to design of relief sewers.

Flow data should be recorded every 15 minutes and averaged to determine the hourly flow rate. Flow hydrographs should be developed to present the hourly fluctuations under both dry and wet weather. All flowmeters should be installed to operate concurrently. Such an arrangement provides improved data comparison and reduced overall project costs.

The instruments to monitor flows should be depth and velocity type. Meter operation and accuracy should be verified prior to installation.

Each instrument should be checked routinely to determine if re-calibration is needed. A minimum of four calibration checks should be undertaken during the course of the monitoring period.

Prior to installation, each manhole should be inspected to determine if any special problems might be encountered, i.e., surcharging, extreme depths, debris, etc. Once this is ascertained, the installation can be initiated. The operation and maintenance of these meters can likely be handled by a crew of two properly trained people. The typical checking cycle is once per week. However, more frequent checking should be performed if it is shown to be necessary for proper meter operation. Each instrument should be inspected to confirm operation of the meter. The depth and velocity sensors should be inspected to ensure they are clean and free of any debris. A formal log of each such check should be recorded and filed. The manhole number (meter location), date, time on meter, and the time of manual depth verification should be indicated on the log. A written record should be maintained by field personnel for each monitoring point for each site inspection.

8.2.2.1.3 Task 3. Flow and Rainfall Data Analysis

The flow and rainfall data analysis should be performed to verify conclusions derived from data collected in 1993 and any changes in the system. Adequate rainfall is necessary to establish the relationship between peak inflow and rainfall intensity. The relationship is used to determine the impact on the collection system during wet weather conditions. A correlation of peak inflow to rainfall intensity is made.

In order to develop a relationship between monitored flows and rainfall events, it is necessary to accurately record various storm intensity and durations. Continuously recording rainfall recorders should be installed. Data from the rain gauges should be used to establish the intensity of rainfall and duration for each storm event.

Initial analysis of flow data should be performed by reading and producing a listing of the raw data. This listing should be presented in 15-minute increments and represent the average of each reading. Further analysis of the flow data should be performed by plotting the flow data hydrographs with the flows plotted every hour, and graph of the rainfall. Once the initial analysis has been performed, the data should be analyzed by generating a flow data summary consisting of an analysis of the total daily flow and an analysis of the extraneous flows for those days with infiltration and/or inflow present. The theoretical flow and typical dry weather infiltration rates should be used to determine the extraneous flow quantities, and the total extraneous flow will then be divided into the high groundwater infiltration and/or inflow quantities. Data developed during this phase of the analysis for each monitoring site should include:

- Average base flow under dry weather/low groundwater conditions and diurnal peak base flow values.
- Infiltration rates under dry weather/high groundwater conditions.
- Peak inflow rates under various storm events.
- Capacity analysis at the monitoring sites (theoretical and actual comparisons).

8.2.2.2 Phase II—Detailed System Inspections

The focus of the work is to identify high rate, easily removable sources of I/I such as downspouts, area drains, catch basins, cross connections with storm conveyance system and manhole defects.

Phase II will be in the areas where physical inspections are necessary to resolve system overloaded and structural problems. Activities should be initiated concurrently, in the high priority areas, with the flow monitoring. Detailed inspections should include the following field inspection activities:

- Manhole inspections.
- Line lamping.

- Smoke testing/dyed water testing.
- Dyed water testing.
- Cleaning/Television inspections.

The inspections should be performed on a selective basis to determine which sub-areas justify further analysis. The approach should include training, ongoing technical guidance, use of standardized field input forms, data review and input, and quality control to insure continuity between inspection crews and an accurate and working system database. It is critical that a process be established and followed to assure that system deficiencies identified during these field inspections are well documented and are monitored until satisfactorily addressed.

8.2.2.2.1 Task 1. Manhole Inspections and Line Lamping

Comprehensive internal manhole inspections and line lamping should be performed to identify manhole sources of infiltration and inflow and to evaluate the overall maintenance condition of the manhole. All manholes in each sub-area should be inspected. It is likely that significant numbers of manhole and sewer defects will be identified. The inspections should:

- Identify structural and hydraulic conditions and prioritize manhole I/I sources;
- Identify maintenance conditions of the manhole and sewer lines;
- Provide manhole depth data which could be used in conjunction with a rim elevation survey to update system elevation data;
- Provide data to confirm or revise existing map information;
- Help establish sewer line maintenance needs; and,
- Prioritize lines for TV inspection.

Each manhole inspected should be entered and every line entering the manhole should also be partially inspected by lamping. Lamping inspection of each line should be by means of a flashlight or flashlight and mirror. The information allows for evaluation of a manhole's structural integrity and potential for leakage, as well as gathering pertinent information for rehabilitation design. Selective photographs should be used to document typical I/I sources and special conditions.

A reasonable attempt should be made to inspect manholes. Manholes which are buried or are not accessible because of shrubbery, fences, or dogs should be noted as such

and reported. A second inspection attempt should be made if access can be provided within a reasonable time after completion of the initial inspection attempts.

8.2.2.2.2 Task 2. Smoke Testing

Smoke testing should be performed to identify sources of infiltration and inflow in both the public and private sectors of the sewer system. All lines in each sub-area should be smoke tested. Notification of each building owner/tenant in the test area will be made by distributing door hanger notices within one week of the test.

Smoke testing should be performed on single sewer segments for each test. Air flow should be restricted at the upstream and downstream sewer section and a non-toxic smoke should be pumped into the sewer section by a blower. All sides of buildings and the entire area in the vicinity of the sewer segment being tested should be observed by a three or four person crew. Testing should include observation of suspect private sector sources such as are drains and downspouts piped underground which do not smoke. Detailed sketches should be made of positive and suspect sources. Selective photographs will be taken for documentation of confirmed sources and to record suspect sources for subsequent dyed water testing. Recommendations for television inspection of the sewer segment should be made.

Smoke test documentation for cross-connections should identify which inlet was smoking on a sketch showing nearby sanitary lines and known storm lines.

Data should be summarized on computer coded field forms and input into a database for storage, sorting and retrieval.

8.2.2.2.3 Task 3. Dyed Water Test (Public Sector)

Dyed water testing in the public sector should be performed to more accurately locate and quantify sources which were identified during smoke testing or which are otherwise suspect. The numbers of tests required depends on the previous test results. Dyed water testing should be performed by flooding the test section or area with dyed water and observing the sanitary sewer for the presence of dye. The presence of dye indicates a positive test and the location of dye entry is noted. Estimates of leakage rate will be made by direct measurement or by judgment based on the appearance of dye concentration in the sanitary sewer. Dyed water tests should also be performed with concurrent television work as necessary to locate and quantify system defects. Television work performed as part of this task should include video tape review, summary, and data entry into project database. Data should be summarized on computer coded field forms and input into a database for storage, sorting and retrieval.

8.2.2.2.4 Task 4. Dyed Water Test (Private Sector)

Dyed water testing in the private sector should be performed to determine if suspect sources identified during smoke testing are connected to the sanitary sewer system. The numbers of test required depends on the previous test results. Suspect sources are area drains and downspouts piped underground which do not smoke during smoke testing and whose discharge location is unknown. Dye water testing should be performed by injecting dyed water into the suspect source and observing the sanitary sewer for the presence of dye. The presence of dye indicates a positive test and indicates a connection. Estimates of leakage rate should be made by direct measurement or based on the tributary area to the source. Data should be summarized on computer coded field forms and input into a database for storage, sorting and retrieval.

8.2.2.2.5 Task 5. Television Inspections

Selective television inspections should be performed to identify pipe infiltration sources, pipe structural condition, and to locate inflow source identified from dyed water testing. Results of any flow isolation tests, smoke testing, line lamping, and dyed water testing should be used to select lines to be televised. Video tapes should be reviewed and summarized on computer coded field forms and input into a database for storage, sorting and retrieval.

8.2.2.2.6 Task 6. Inspection Data Report

While it is anticipated that some system deficiencies with obvious repair and/or rehabilitation methods will be addressed immediately or shortly after identification of the deficiency, a report for Phase II should be prepared summarizing and analyzing all new data. An implementation plan should be updated considering a revised cost-effectiveness analysis. At the completion of Phase II for each basin service area, The City of Bryan should proceed with any remaining design and construction activities. Recommended improvements should be prioritized with planning level cost estimates.

8.2.2.3 Phase III—Post Rehabilitation

8.2.2.3.1 Task 1. Post-Rehabilitation Evaluation

Post-rehabilitation flow monitoring should be conducted to verify effects of rehabilitation methods. Actual I/I removal rates versus those predicted should be

confirmed. Rehabilitation methods should be modified as necessary to maximize I/I removal for future projects.

8.2.2.3.2 Task 2. Capacity, Management, Operations and Management Plan

Conduct continued monitoring assessment and adjustment of implemented measures to meet the requirements of CMOM.

8.2.3 Utilize Computer Hydraulic Model

The computer hydraulic model (XP-SWMM) provided as a part of the development of the Master Plan is a powerful tool. It can provide valuable data in the capacity, management, operations and maintenance of the existing collection system and planning for future development. Examples of utilization are as follows:

- Input the results of future flow and rainfall monitoring and analysis into the hydraulic model to allow evaluation of the wastewater collection system based on updated information.
- Input modifications and expansion of wastewater collection system to verify affects.
- Input loads from planned developments to determine affects of the development on the existing system and preliminarily identify required system improvements.

It is recommended that The City of Bryan maintain trained staff to fully utilize and maintain this tool.

8.2.4 Burton Creek Wastewater Treatment Plant

Recommended improvements to the Burton Creek Wastewater Treatment Plant are as follows:

- For the short term, improve treatment capacity of the plant by making improvements to the primary clarifier, the trickling filter and aeration basin blowers.
- Conduct detailed hydraulic evaluation of the plant, including developing a plant hydraulic profile and computational fluid dynamic modeling of the final

clarifiers to verify specific causes of hydraulic problems experienced by the plant during peak flow events.

- Reduce inflow and infiltration entering process units.
- Coordinate modifications and expansions to plant with improvements to collection system.

8.2.5 Still Creek Wastewater Treatment Plant

Recommended improvements to the Still Creek Wastewater Treatment Plant are as follows:

- Consider a new Westside Wastewater Treatment Plant near the Brazos River and eventually remove the Still Creek Wastewater Treatment Plant from service.
- For the short term, improve treatment capacity of the plant by making improvements to the primary clarifier and aeration basin blowers.
- Conduct detailed hydraulic evaluation of the plant, including developing a plant hydraulic profile and computational fluid dynamic modeling of the final clarifiers to verify specific causes of hydraulic problems experienced by the plant during peak flow events.
- Reduce inflow and infiltration entering process units.
- Coordinate modifications and expansions to plant with improvements to collection system.

8.2.6 Turkey Creek Wastewater Treatment Plant

Recommended improvements to the Turkey Creek Wastewater Treatment Plant are as follows:

- Consider a new Westside Wastewater Treatment Plant near the Brazos River and eventually remove the Turkey Creek Wastewater Treatment Plant from service.
- For the short term, improve treatment capacity of the plant by making improvements to the primary clarifier, the trickling filter and aeration basin blowers.

- Reduce I/I entering process units.

8.2.7 Westside Wastewater Treatment Plant

It is recommended that the Still Creek and Turkey Creek Wastewater Treatment Plants eventually be removed from service and a wastewater treatment plant be developed on the west side of The City of Bryan near the Brazos River. It is recommended that planning for the Westside Wastewater Treatment Plant begin immediately.

8.3 Opinion of Probable Costs

The Summary of Opinion of Probable Costs is included in Chapter 7. Costs for improvements to Still, Turkey and Burton Creek Wastewater Treatment Plants are not included.

City of Bryan
Wastewater Collection System Master Plan
Table 8-1
Summary of Plan - Completion by 2005

Item	Opinion of Probable Costs 2005 ($ - 2005 Basis)	2010 ($ - 2010 Basis)	2015 ($ - 2015 Basis)	2020 ($ - 2020 Basis)
Relief Sewers (1)	$66,205,029	N/A	N/A	N/A
I/I Management Program (2)	$9,810,000	N/A	N/A	N/A
Rehabilitation (3)	$25,400,000	N/A	N/A	N/A
Sewer Extensions (4)	$116,375,262	N/A	N/A	N/A
West Side WWTP (5)	$16,390,905	N/A	N/A	N/A
Total	$234,181,196	$0	$0	$0
Grand Total				$234,181,196

Table 8-2
Summary of Plan - Phased Completion

Item	Opinion of Probable Costs 2005 ($ - 2005 Basis)	2010 ($ - 2010 Basis)	2015 ($ - 2015 Basis)	2020 ($ - 2020 Basis)
Relief Sewers (1)	$28,282,069	$23,118,657	$11,023,911	$15,233,460
I/I Management Program (2)	$3,270,000	$3,810,000	$2,205,000	$2,550,000
Rehabilitation (3)	$5,450,000	$12,700,000	$3,675,000	$4,250,000
Sewer Extensions (4)	$9,679,731	$45,119,468	$45,146,618	$53,254,064
West Side WWTP (5)	$0	$19,050,000	$0	$0
Total	$46,681,800	$103,798,125	$62,050,529	$75,287,524
Grand Total				$287,817,978

Notes

(1) Improvements to Existing System Including Capacity For Growth To Year 2020 Based on Successfully Removing 40% Inflow and Infiltration
(2) Identification of Sources of Inflow and Infiltration in Existing System
(3) Rehabilitation of Existing System to Reduce Inflow and Infiltration by 40% - Dependent on I/I Management Program Findings
(4) Dependent on Rate and Location of Growth
(5) Wastewater Treatment Plant to Consolidate Flows From Still Creek and Turkey Creek WWTPs and Divert Existing WWTPs.